Edward D. Goldberg:
Chemical Descriptions
of the Ocean

Edited at the
Massachusetts Institute of Technology
June, 1970. Price, $1.25

Urban Transport We Could Really Use/Pure Technology/British Town Planning in Transition/Operations Research in a City Police Department

Technology Review

technology
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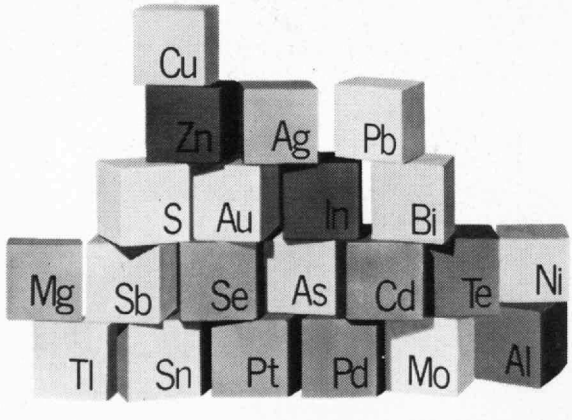

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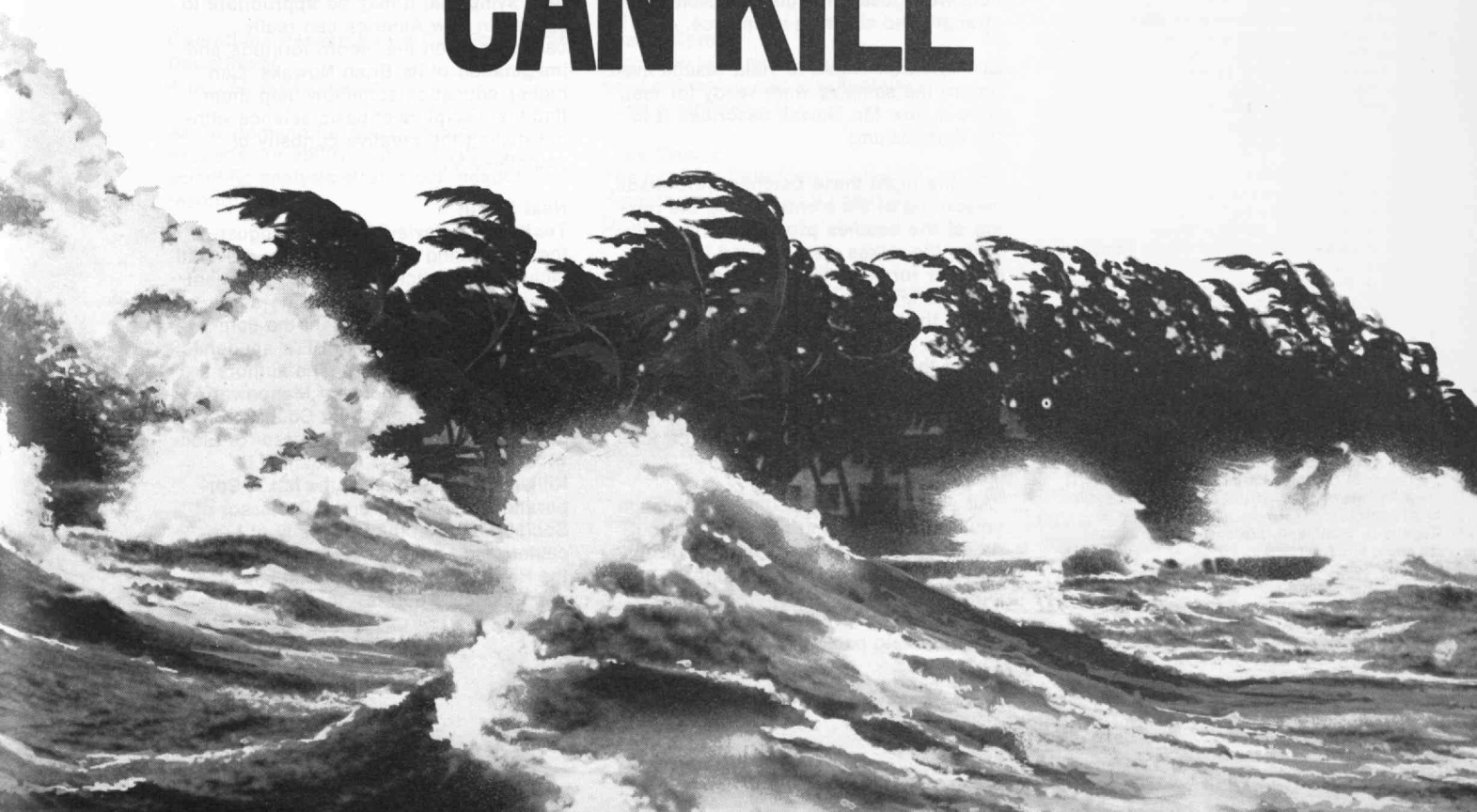
A SURPRISE CAN KILL



A hurricane.

Six hundred people were killed by one in New England in 1938.

Four years later, eleven thousand were killed by one in India.

The winds of a hurricane are over 75 miles an hour.

It takes the form of a circle or an oval, sometimes as much as 500 miles in diameter.

There is no prevention.

But if we reduce the element of surprise, we can reduce its deadly potential.

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RCA has designed, developed and produced the world's most advanced family of weather satellites. It's called the ITOS program.

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It is becoming increasingly more apparent that in the future, the engineer will touch virtually every aspect of our lives. From medicine to the arts to education to leisure products.

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Because everywhere is needed the forward look of creative technology.

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If you're interested in a comprehensive index of over 1100 technical papers published by RCA scientists and engineers during 1969, let us know.

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Edited at the
Massachusetts Institute of Technology
Volume 72, Number 8
June, 1970

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Inquiries regarding editorial contents, subscriptions, and advertising should be addressed to: Technology Review, Room E19-430, Massachusetts Institute of Technology, Cambridge, Mass., 02139. Telephone area code (617) 864-6900, ext. 4872.

Technology Review is printed by the Lew A. Cummings Company, Manchester, New Hampshire. Second class postage paid at Manchester, New Hampshire.

Price: $1.25 per copy, $9 per year in the United States, $10 in Canada and foreign countries. Please allow three weeks for changes of address, and give both old and new addresses in all requests.

Technology Review is represented for advertising by: Specifax Media Sales, Inc., 603 E. 82nd Street, New York, N.Y., 10028, telephone (212) 249-7768. and 415 S.W. First Street, Fort Lauderdale, Fla., 33314, telephone (305) 584-4565; MediaRep Center, Inc., 1127 Statler Office Building, Boston, Mass., 02116, telephone (617) 542-7720; and Whaley-Simpson Co., Inc., 6725 Sunset Boulevard, Los Angeles, Calif., 90028, telephone (213) 463-7157, and 580 Washington Street, San Francisco, Calif., 94111, telephone (415) 781-4583.

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The First Line

Upon seeing a brief account in *Technology Review* (*February, 1970, p. 66*) of work at Stanford University to use powder made from waste glass as a concrete aggregate, K. Brian Nowak, who is a senior at Framingham (Mass.) South High School, has submitted to the *Review* a copy of his manuscript on "Noncombustible Refuse as Aggregate" which he presented to the Northern New England Junior Science and Humanities Symposium at the University of Massachusetts early this spring.

He agrees that there is precedent for the work of Stanford's Cedric W. Richards—including his own experiments on the use of noncombustible refuse of various kinds to yield properties required of concrete aggregate: resistance to thawing and freezing, resistance to abrasion, chemical stability, weight, and texture.

Mr. Richards salvaged and sorted material from a nearby dump and mixed his own concrete with various proportions of different aggregates, cement, and water; he also prepared a control sample using conventional rock aggregates. The products were tested for compression strength and abrasion resistance.

But research began to yield results even before the samples were ready for test. Here is how Mr. Nowak described it to the Symposium:

"On the night these batches were made, measuring of the elements and the mixing of the batches proceeded normally. When the mixes were poured into the cylinder forms, strange things began to happen. Little bubbles started coming out of the tops of the three experimental batches. As the time of curing increased so did the rate of bubbling. Out of curiosity, I decided to light a match over the escaping gases and to my surprise these tiny bubbles exploded with a loud pop.

"All sorts of crazy thoughts run through your head at 10:00 at night after a hard day at school. I pictured the catastrophe resulting from a driver's lighting a cigarette next to his concrete truck pouring my mix. It might set the construction field back fifty years!"

Further examination the next day revealed a white powder surrounding the holes through which the gas emerged, and Mr. Nowak describes the series of analytical procedures—reaction temperature, flame test, acid-base test, weight measurement, etc.—which he then used on the gas and its powder residue. Finally he concluded that calcium oxide was a major powder constituent but in fact the gas mixture was too complex for him to identify.

This sub-project behind him, Mr. Nowak went back to the original problem, cleansed his aggregates as best he could, and proceeded again to make concrete. Results: concrete made with ceramic aggregate was strongest in compression test—but failed an abrasion test.

Can you, nevertheless, imagine a use for ceramic-aggregate concrete? Yes, wrote Mr. Nowak, who hopes to study architecture: "Interesting walls for buildings could be made by using glass aggregate and chipping away the outside layer, exposing a jeweled surface beneath."

In the season of science fairs and student symposia, it may be appropriate to ask again how America can really capitalize upon the inborn fortitude and imagination of its Brian Nowaks. Can higher education somehow help them find the discipline of basic science without dulling the creative curiosity of youth?—J.M.

Next Month

Technology Review for July/August—the concluding issue of Volume 72—will include five articles on topics pertinent to higher education in science and engineering, to complement the commission now studying M.I.T.'s academic programs for the 1970's. The authors are John D. Alden, Director of Manpower Activities for Engineers Joint Council; Gordon S. Brown, Jackson Professor of Electrical Engineering, M.I.T.; James R. Killian, Jr., Chairman of the M.I.T. Corporation; Harold J. Perkin, Professor of Social History at the University of Lancaster; and Miriam L. Yevick, Director of the Retraining Program in Mathematics and Science, Rutgers—the State University.

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for
June, 1970

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Trend of Affairs

Cambridge Journal

"Wanting more food from the ocean is one thing. Getting it is another," says Art Tuthill of International Nickel.

"Extracting food from the ocean in large quantities takes special machinery.

"Special machinery to get the food.

"Special machinery to process the food.

"Special machinery to transport the food.

"And most important, special machinery that can stand up to the sea.

"Machinery made of materials that will last. Reliable materials priced reasonably enough to make large, intricate machinery self-sufficient and financially practical.

"That's my job at International Nickel," says Tuthill. "Working with the marine industry, interpreting their needs to our researchers. In an effort to develop special materials that will resist the sea's extreme pressures and corrosion.

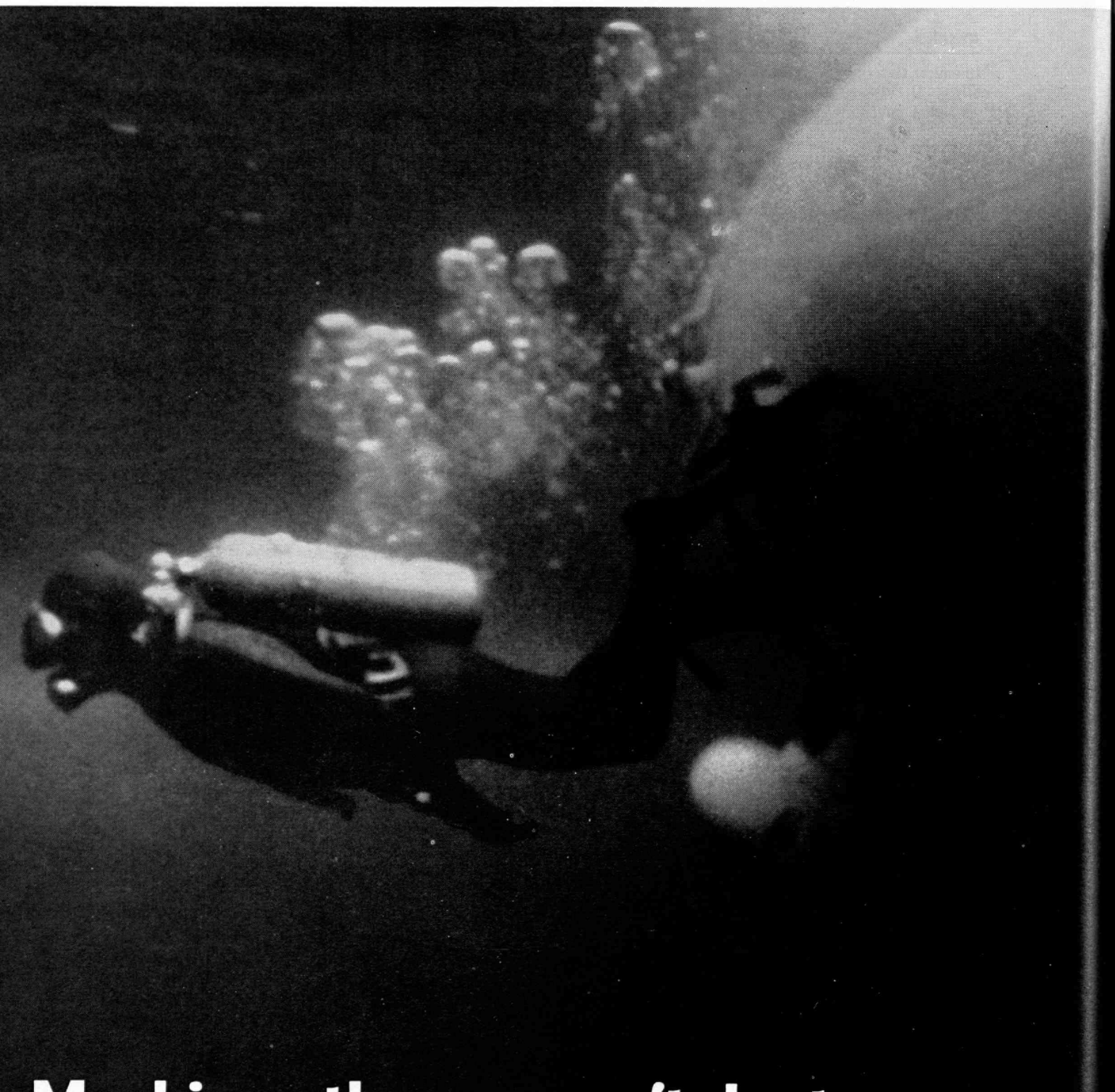
"We already have alloys of copper and nickel, nickel alloy steels and certain stainless steels, that fulfill these requirements.

"Nickel maraging steel enabled Lockheed's *Deep Quest* to dive to a record depth of 8,310 feet withstand fantastic pressure and stress.

"Copper nickels have made desalination possible at reasonable And are beginning to find a home in kinds of boats that work the sea. Figh hard against salt water corrosion.

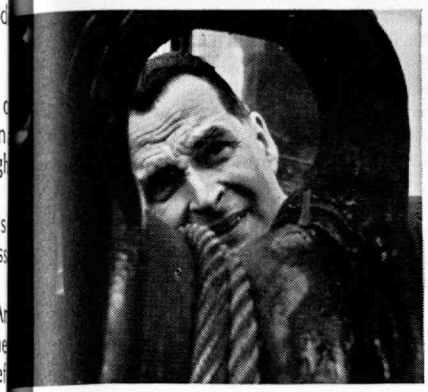
"And special grades of stainless assure the sanitary conditions neces for processing the catch.

"We have the materials now. A the faster they're made into machine sea can't destroy, the faster the relie



Machines the sea can't destroy.

one billion underfed people of
orld."



Nickel helps other metals resist heat, cold, impact, pressure, abrasion, corrosion... to advance engineering in vital fields—power, desalination, electronics, transportation, aerospace.

We're doing everything we can to produce more nickel. Searching around the world—Indonesia, Australia, Guatemala, Canada. We've found ways to extract nickel from ores thought too poor to mine a few years ago.

We count our blessings and respect our surroundings. From nickel ores, we recover platinum, palladium, twelve other commercially useful elements. Make iron pellets for steel. Convert smoke in our stacks to chemicals for other industries. On sand left from processing ore, we grow meadows of hay.

We are explorers. We're in 18 countries. Miners, researchers, market builders—we bring opportunity to underdeveloped lands, new technologies, new payrolls, new tax income. Nickel in the ground is useless. We put it to work.

INTERNATIONAL NICKEL

Lockheed's *Deep Quest*

Scientists as well as science writers have been trapped by oversimplifying the keys needed to open the locks on the archives of the universe. But the exercise—even if it fails—is not without its purpose

Big Bang or Steady State?

For me, at least, it's always a joy to see Britain's doughty cosmologist Fred Hoyle bounce back from a knockdown. He does it with such verve and imagination. Right now, he's riding high over critics of his steady state theory of the universe, critics who thought a few years ago that they had sent him down to virtually certain defeat.

In fact, when he recently gave the 61st Kelvin Lecture to the Institution of Electrical Engineers in London, he said he was about ready to take bets that his critics' big bang theories would soon be dead. Perhaps those critics should take him up on this. Unexpected aspects of the universe, such as the recent discoveries which tripped them up, may still lie in wait to humble Professor Hoyle.

Certainly such things have humbled me as a science writer. It will take a lot of persuasion before I again write enthusiastically about cosmologists having found a "key to the archives of the universe" that within a few years should enable them to decide whether it's the big bang or the steady state view that makes the most sense. No, I won't swallow that one again even if distinguished astronomers from the California Institute of Technology confidently proclaim it, as a few of them and some others were doing in the mid-1960's.

in those days, the steady state notion was making heavy weather. It holds that the universe has no definite end or beginning. It always looks more or less the same, on the overall scale at least. As galaxies move outward as part of a general expansion of the universe, new ones form from matter spontaneously created. Big bang theories, on the contrary, envision the cosmos starting out from the explosion of a dense energy mass and evolving from there. Galaxies and other objects condense gradually from matter created in the primordial blast. Some big bang theories consider the universe to be oscillating, alternately expanding, contracting into a dense energy mass, and exploding outward again. Most of the theories just have the universe expanding indefinitely.

One way to decide between the main rival views would be to take a good look at the universe many billions of years ago. If it's in a steady state, its galaxies and other major objects should be spread around much as they are today. If it's evolving out of a big bang, the ancient view would be distinctively different. The confident cosmologists of the mid-1960s thought they were beginning to get their hands on this kind of definitive ancient history.

Some, such as Cambridge radio astronomer Martin Ryle, thought to do it by counting fainter and fainter radio sources. He assumed that the fainter the source, generally, the farther away it was. And, since radiation from distant sources takes so long to reach us, it shows those sources as they were billions of years ago.

For a while, Sir Martin and some others thought this kind of radio source count was favoring the big bang theory. Sir Martin insisted he had the steady staters, especially Dr. Hoyle, on the run. Fellow columnist Victor McElheny, who attended Sir Martin's first account of these studies at the Royal Society some years ago, described him as grinning like the proverbial canary-eating cat.

But in the intervening years the exercise of source counting has remained indecisive. At best, it has given only a fuzzy suggestion that the big bang theory may be right. And very recent results from Australia, not yet published at this writing, indicate that the progress in source counting is tending if anything to swing away from big bang predictions.

Fitting the Lock on the Archives

Then there were the quasars (quasi-stellar objects). So tiny they appear no larger than stars of our own galaxy in astronomers' photographs, some of these enigmatic objects have the greatest red shifts that astronomers know. When a light-emitting object moves away, as objects must if they are taking part in the general expansion of the universe, spectral lines in their light are shifted toward the red end of the spectrum. The faster they recede, the greater this red shift. Also, the faster they recede as part of the universe's expansion, the farther away they are. Astronomers have come to associate red shift with distance. So after Dr. Maarten Schmidt of Caltech and the Hale Observatories (Mount Wilson and Palomar) measured the first quasar red shift in 1963, astronomers recognized two dramatic implications.

To shine as brightly as they do from their assumed great distances, quasars would have to outshine an ordinary galaxy of stars thirty to a hundredfold. Yet they are almost incredibly tiny. Estimates of quasar energy-producing regions now range down to a few light years, light months, or even smaller, in diameter. This raised the awesome question: How can such enormous energies be produced and poured out of such tiny volumes? How can such superdense energy sources form?

Astronomers hadn't (and still haven't) a clue to the quasars' real nature. But if these objects are really as distant as their red shifts indicate, counting their distribution should at least help settle the cosmological debate. Half a decade ago, quasar counters such as Dr. Schmidt's colleague Allan R. Sandage were telling audiences that the debate might well be settled within a few years and already it looked like the big bang by a landslide. But unfortunately for such optimists, the quasar key doesn't fit the lock on the universe's archives. As it turns out, there's no discernible correlation between quasar red shifts and quasar brightnesses. Some of the fainter, and presumably more distant, of them have the smaller red shifts. In fact, it's a moot question whether red shifts are related to quasar distance or are generated by some as yet unknown effect. Right now, no one knows at what distance quasars lie. Counting them tells you nothing about the big bang vs. steady state competition.

Black Body and Big Bang

Even the strongest evidence favoring a big bang, the so-called background radiation, is turning fuzzy. Big bang theory predicts that some radiation would be left over from the primordial explosion. It would permeate the universe today, looking like the thermal radiation from a 3° K. black body. When Arno A. Penzias and Robert W. Wilson of the Bell Telephone Laboratories in 1965 dis-

covered faint radio waves arriving at earth from all directions, big bang advocates thought they had it made. At the frequency of the Telstar communications satellite, where the Bell researchers were listening, the radiation was consistent with a 3° K. background. Since then, a number of observations at other frequencies have also fitted his black body radiation spectrum.

But last year rocket-borne detectors from the Naval Research Laboratories and Cornell University picked up the background radiation and found that, in the infrared, it doesn't seem to fit the desired black body spectrum at all. Their results were condemned as inaccurate until M.I.T.'s Dirk Muehlner and Rainer Weiss looked at that radiation with a balloon-borne detector. Although their data, too, are open to various interpretations, they do tend to support the rocket findings. The existence of a background of radiation in the universe can no longer be taken automatically as support for a big bang view. It might be due to non-thermal processes, perhaps within the galaxies.

At University College, London, G. Burbidge of the University of California, one of the leading astronomical theorists today, recently reviewed the trends in the evidence. He concluded that the kinds of criticism that seemed to be demolishing the steady state view a few years ago have become "rather shaky." This is one reason Dr. Hoyle now feels a bit like a reinstated king of cosmology. He's also pleased with the striking discoveries of widespread centers of violent action throughout the universe.

Galactic Action Centers

In the past few years, astronomers have come to realize that quasars are far from being "the queerest objects in the universe," as we used to describe them. The cores of the Seyfert galaxies—indeed, cores of most galaxies including our own—are just as queer.

Named for Karl Seyfert, who studied them extensively in 1943, the Seyferts are galaxies with small very bright centers of action in their cores. These centers pour out quasar-like energies from quasar-sized volumes. In fact, except that they are in recognizable galaxies of stars, these action centers seem very like quasars themselves. Even an "ordinary" galaxy like our own Milky Way system has such action centers in its core. They are particularly evident in the Infrared where, astronomers are discovering, much of the energy output of cosmic objects lies. Dr. Burbidge said our galaxy could be thought of as a weak Seyfert, about 1,000 times less energetic than a true Seyfert, but with equally puzzling superdense, supertiny energy-producing regions in its core.

Many galaxy cores are also shooting out enormous amounts of matter. Even our own galaxy spews out masses of gas. Some have large jets emerging from them. They may have shot out as much matter as a whole galaxy contains, if indeed they are not now producing new galaxies as some experts suspect. Dr. Burbidge says you have to think in terms of action centers that, over their lifetime at least, emit the mass equivalent of a galaxy. How they form and how they produce their enormous energies has become a central question for cosmology and astrophysics. Its perplexity has driven a few theorists to look again at a decades-old suggestion of the late James Jeans that new matter may be entering the universe in the centers of galaxies.

This suggestion fits Dr. Hoyle's ideas nicely. He gave up on the notion of matter appearing spontaneously throughout space some years ago. With his colleague J. V. Narlikar, he has adapted steady state theory to the concept of new matter being created in centers of high density. These are just the kind of centers astronomers have found so common in the universe and currently so inexplicable.

Some experts, including Dr. Hoyle, think the basic laws of physics may have to be reworked to apply in such dense action centers which present concepts are, they feel, inadequate to explain. In fact, Dr. Hoyle is working out a new formulation for electrodynamics which he claims does everything the standard theory does plus clearing up some of that theory's ambiguities. In his new theory, Hoyle—among other things—starts out with the assumption that radiating particles can send energy traveling backward in time as well as forward. You might say they emit signals that, for an observer, arrive from the future.

Physicists haven't taken this sort of thing seriously yet. And even Dr. Hoyle, earnest as he is about his new theory, regards it as a rather far out notion. He quipped to the engineers that "now you can say he's come up with something crazier than the steady state." Still, he thinks his theory says something about cosmology. Only an oscillating big bang or a steady state universe is compatible with it. He left the engineers in no doubt as to which he thinks it is.

Invigorating Astronomical Science

In a field as rife with rivalry and jealousy as astrophysics, Dr. Hoyle inevitably has his personal critics. They question his real contribution as a scientist. They suggest he is more a publicist and personal promoter than an advancer of knowledge. He has indeed become solidly part of the scientific establishment as Vice-President of the Royal Society and a member of the faculty at Caltech as well as at Cambridge. But I think Martin Ryle, certainly one of his strongest rivals in the realm of ideas, has a fairer, more accurate view.

Discussing this once in an interview, he said that Fred Hoyle makes two major kinds of contribution. For one thing, he has elucidated many basic processes in astrophysics. More importantly, he has produced a wealth of imaginative suggestions that have provoked a rich harvest of investigations, especially by those out to prove him wrong. With his imaginative, far out, sometimes flamboyant theorizing he has helped invigorate astronomical science, Sir Martin said. And speaking from a science editor's viewpoint, his popular presentations have done much to help the public get a better grasp of astronomy.

So it's probably a productive stimulus, as well as good fun, when Dr. Hoyle goes about acting like an intellectual conquerer these days, even though you suspect a new discovery may cut him down at any time.

Robert C. Cowen, who studied meteorology at M.I.T., is stationed in London as Science Editor of the Christian Science Monitor. *He is a member of* Technology Review's *Editorial Advisory Board and a regular contributor to this column.*

Overseas Report
Daniel S. Greenberg

For many years, Israel has been attempting to turn its scientific expertise to commercial use. Partly due to the decline in U.S. aid for pure science, the long-awaited change may now be happening

To Fulfil the Prophecies

Prior to visiting Israel recently, I read through a ten-year collection of news clippings and reports on Israeli science and technology. Throughout this material, one theme was constant: Israel had built up a relatively strong base for fundamental research, but outside of agriculture, had neglected the growth of applied research and science-based industry. Now, at last—it was repeatedly stated in the decade-long collection—something was about to be done about the neglect. This would be accomplished through the development of industrial parks adjacent to academic centers, government subsidies for applied and industrial research, and encouragement for academic scientists to move between campus and industry. Israel, as the saying there goes, is too small to build a Route 128, but through a combination of scientific and business skills could realistically aim for a "Route 1.28."

Well, after all those years of hopeful talk, the fact is that the Israeli economy is anything but science-based; it is based more on citrus than on solid state—as revealed by export figures, which show that the former brought in $88 million last year, while the country's total sales of domestically produced electronics products, at home and abroad, was around $5 million. Nevertheless, I'll add a familiar note to that ten-year accumulation of clippings and reports: Israel is embarked on a concerted effort toward the development of science-based industry.

But this time it looks as though she might make it, for with the Six-Day War now entering its fourth year, necessity is taking the place of wishful thinking, and carefully devised institutional arrangements are being implemented to make that difficult jump from a good idea to a money-making product.

For example, take the case of the Yissum (Hebrew for "application") Research Development Company, which was established in 1964 by the Hebrew University of Jerusalem in an effort to derive profit from research at the university. D. Simon, director of Yissum, explained in an interview that, initially, a good deal of effort was devoted to obtaining patents on inventions made in the university laboratories. About 40 were actually obtained, at some considerable cost, but then, as Simon put it, "Nothing happened. It turned out that we had no real skill for evaluating the market place and that we had no link to industry. All we had was patents. So," he continued, "we've switched from patent protection to joint operations with going companies. What we want to do is join our inventiveness to their industrial and commercial knowledge. I think we've learned a lesson," Simon concluded.

Links with U.S. Industry

More than 20 such arrangements are now in force, including one between Yissum and Miles Laboratories, Inc., of Elkhart, Ind. Together they have formed Ames-Yissum, Ltd., which operates a plant in Jerusalem for the manufacture of a thyroid-disorder diagnostic kit that was developed at the university. With Miles supplying managerial and marketing experience, and paying all postdevelopment costs, the partnership is apparently working out to everyone's satisfaction. Production began in 1969, and sales for the first year were around $220,000, considerably more than was originally expected. Company officials are confident that they will hit the $1-million mark in sales next year. Miles holds 60 per cent ownership of the joint operation, Yissum 40 per cent.

In a further quest for profit from its research capabilities, Hebrew University has entered into an agreement with a newly created American-backed company, the Scopus Scientific Corporation, which aims to raise and invest $5 million in research projects at the university, in return for exclusive rights to exploit the results commercially. Yissum will receive about 12 per cent of the Scopus stock. But more important than that, it will get, through Scopus, market and industrial know-how, which Israel has come to recognize as perhaps its greatest lack in the drive toward science-based industry.

In Israel they have duly taken note of those analysts of American innovativeness who have concluded that while research is an indispensable ingredient for developing new products, it is a relatively minor step on the long and costly path to success in the market place. With a population of only 2.8 million, and no access to neighboring markets, Israel lacks the home purchasing power that provides a powerful underpinning for Japan's extraordinary success in developing and exporting sophisticated manufactured products. In many instances, therefore, the answer is in a linkup with a major foreign organization, particularly one that already has a sales organization in the field.

Though Israel has long talked of industrial parks, its very biggest will come into being all at once later this year when ELRON Electronics Industries, of Haifa, moves to an industrial park that is being opened near the campus of the Technion. Other research organizations are to follow ELRON; meanwhile an industrial park is being established in Jerusalem, under the auspices of the Hebrew University and the city and national authorities. And in the vicinity of the Weizmann Institute, at Rehovot, about a dozen research-oriented firms have set up facilities, many of them in a nearby industrial park.

But the scale of all this is strikingly small. Some of the firms listed in the Rehovot area employ fewer than ten people. The largest, Israel Electro-Optical Industries Ltd., lists 226 employees, of whom 26 are university graduates. In this context, ELRON is a big league employer. Beginning in 1956 as a three-man, one-room operation, it today employs a staff of over 800, including 160 physicists, engineers, and mathematicians. And ELRON is expanding rapidly in line with the government's desire to promote as much domestic self-sufficiency as possible in electronics. At present, the government takes half its sales, and, under a policy of sharing half of all industrial research costs, has awarded ELRON some $500,000 for research and development support this year. The company has been experiencing rapid growth in exports of its products, which include a small digital computer, computer control systems, and medical monitoring and nuclear research instruments.

ELRON, too, has found it profitable to link some of its activities to large-scale foreign organizations. Thus, in 1968 ELRON's digital instrumentation division became a subsidiary of Monsanto (known as Monsel), and through Monsanto's marketing organization offers an extensive

line of equipment, including digital comparators, digital to analog converters, and decade counters. ELRON is booming and exceeding its sales projections this year. But annual foreign and domestic sales are yet to reach $5 million.

Israel takes considerable pride in ELRON and regards it as a hopeful sign of the potential for science-based industries. But after years of rather ethereal talk, it is now realized that there is no magic route to industrial prosperity. It is also realized that Israel is a rather late arrival on a hotly competitive international scene.

Less Pure, More Applied

The drive to build science-based industries has inevitably turned attention to Israel's academic research centers, among which the Weizmann Institute, Hebrew University and the Technion are big-scale institutions by any international standard. And, in the ensuing examinations of the resources and programs of these centers, it has been almost universally concluded that the balance is tipped much too far in the direction of fundamental research. In fact, two-thirds of Israel's civilian research is fundamental, according to the National Council for Research and Development, which is roughly the equivalent of the White House Office of Science and Technology. (Israel's military research activities are almost entirely screened from outside view. The Israelis say that half of their national research effort is in the military area, and that the proportion is growing.)

Small as Israel is, it nevertheless rings with complaints of insufficient coordination of research activities, often in phrases that might easily fit into one or another of the science-policy reports of the major nations. For example, the director of the National Council for Research and Development, Eliezar Tal, told a conference earlier this year, "One of the results of the absence of . . . overall planning is that in certain areas we are creating a surplus of scientific manpower, whereas in others, particularly in technological areas, there is a serious shortage." Tal went on to say that "a land where the major civilian research effort is in the institutions of higher learning needs to develop specific means to exploit this capability for the economy, and to search for means of strengthening the ties between industry and the institutions."

Industrial parks, encouragement of academic consultancies, and subsidies for industrial research are among the measures that are being pushed from outside to promote closer links between academic and industrial organizations. Within the academic centers, there are powerful influences at work to move the balance toward applied research. Prominent among them is the decline of U.S. government support for research in Israeli institutions. Financed under Public Law 480, the sums involved sometimes ran as high as $8 million a year, and while it is difficult to say what proportion of Israeli science was dependent on this money, two things are clear: a very high proportion was so dependent—probably well over 50 per cent—and most of the money was spent on basic research. These funds are due to taper off to near nothing within a couple of years, as a result both of the depletion of U.S.-held local currency in Israel and of congressional opposition to U.S. financing of research abroad. As the money declines, efforts are being made to tap new sources of support, particularly in West Germany, where several philanthropic foundations have developed close relations with Israeli science.

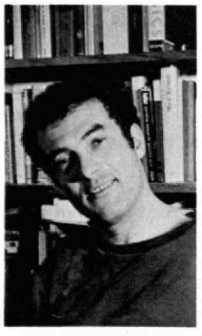
Easier Money in Applied Science

But, for the moment, it is doubtful that full replacement for the U.S. support will be forthcoming, and this situation conveniently dovetails with the Israeli government's desire to steer the academic research centers toward applied research. As one scientist put it, "Anyone who wants to continue doing basic research is free to do so, but it's hard to get money for basic research and it's very easy to get it for applied research. Draw your own conclusions."

If there is any resentment toward the government's pressures for an increase in applied research, it is not readily apparent. Israel's scientists recognize that the country is in a desperately tight spot and that basic research, while possibly of great value in the long run, contributes little or nothing of economic or military value over the short run. It is emphasized, of course, that the country is not dismantling its basic research capability; rather, it is seeking to push the balance toward applied research, perhaps on a 60-40 division, in relation to basic research.

Both Hebrew and Tel Aviv universities have responded to this situation with plans to establish schools of applied science and technology. At the Weizmann Institute, Albert Sabin, who became president there this year, has set up a series of task forces to examine how the Institute might contribute more effectively to the development of science-based industries.

That pile of clippings I referred to should inspire a cautious attitude toward the prospects for Israel's efforts to wring substantial commercial profit from its scientific capabilities. The Israelis have been talking about it for a long, long time. But now it looks as though they are going about it in earnest. One measure of change is that Israel is experiencing the return of a steady trickle of technically trained people who left the country, usually for residence in the U.S., because of lack of professional opportunities. Many of them are returning with five to ten years' experience in American industry and are being quickly absorbed into Israeli industry. That strikes me as a significant omen of change.



Daniel S. Greenberg, who has written extensively in the field of science and politics, is stationed in London as Foreign Editor of Science.

The federal worker is aroused and marching. . . . Professionals and young rebels alike are telling anyone who will listen that there is something wrong throughout the giant Department of Health, Education and Welfare. . . . Without question, there are deep dissatisfaction and anger in health agencies

It Came from the White House

For a zillion years, the doctors and scientists of the National Institutes of Health and its cousin organizations were among the meekest of the meek. They shunned political commitment or public statement, at least *as* government scientists, for fear of budgetary retaliation by unhappy Congressmen.

The meek are no more. They have inherited the plight of the earth. Vietnam has changed all the rules, and the voice of the government bioscientist is being heard with the voices of the professors and the desperate kids. The federal worker, not just in biology and health but in a hundred agencies, is aroused and marching.

The main action, as one might expect, has been with the younger and lower-level lab worker, the restless clerk, the long-haired new doctor and bright-eyed, mini-skirted research assistant. People like these were in the forefront a few months ago when around 300 federal employees—attorneys, scientists, janitors, clean-up ladies—gathered for a Saturday of workshops called the first "Federal Employees' Convention of Peace, Equality and Freedom."

Vietnam, government "misuse" of scientists, the proposition that the government they work for is hypocritical—all were on the agenda. The overall theme was summed up by a *Washington Post* reporter as "a call to guerrilla warfare—within the law of course."

"We are confronting an enormous obstacle," said Dr. David Reiss, a psychiatrist. "We are faced on the one hand with decision makers"—the elected officials—"who are convinced that they're right, and on the other hand with a massive, sluggish bureaucracy that shields the decision makers from the warning signals they need." The archetypal middle-echelon bureaucrat, it was noted, is a man who is "very, very careful."

This gathering was not a huge one, but it was significant. For small or large groups of concerned workers had been meeting for some time in individual agencies, and this session—as a civil rights attorney put it—was "the first time in the history of the Civil Service" that a varied group of federal workers "met to openly question government policies and discuss what they can do."

Within days the Inter-Assembly Council of N.I.H. scientists—the elite M.D.'s and Ph.D.'s, white and well-paid—were raising their voice for 370 ill-paid black janitors, food-handlers, and maintenance workers. These lowest of the low in the federal pay scales were scheduled to undergo a reduction in pay grade as part of a personnel reclassification aimed at agency-wide "uniformity." They would get no immediate pay cuts, but in the future would get only 50 per cent of any general pay raise until their pay matched the new lower grade to which they were being reclassed.

Dr. Robert Q. Marston, N.I.H. Director, himself went to bat for the workers. Doctors and scientists lined up free legal aid. Seventy-five researchers volunteered to testify that N.I.H. workers face unusual hazards: exposure to viruses; handling possibly infectious laundry. For the moment at least the neat little reclassification was postponed for "re-study."

For months a Vietnam-inspired Moratorium Committee had been flourishing on the grassy N.I.H. campus and in the suburban Maryland office buildings where federal health activities have been scattered. The committee went to court to win the right to use government meeting facilities. Among speakers who have addressed crowds in the N.I.H. Clinical Center auditorium have been such anti-establishmentarians as Dr. Benjamin Spock, I. F. Stone, and Dr. Howard Levy, the recalcitrant Army dentist.

The Moratorium Committee was heavily weighted with the young. Cambodia added the old: in mid-May the National Institute of Mental Health—National Eye Institute—National Institute of Neurological Diseases Assembly of Scientists voted 164 to 23 to oppose U.S. involvement in Cambodia. It voted by similar margins to support the Hatfield-McGovern anti-Indochina war resolution and to speak out in the future on similar issues. This was the first time this group—the establishment professionals, from top officials down—had ever taken a nonmedical political action. "When these guys take action," said a younger rebel, "then you know something is wrong."

Mixing Politics and Health

Professionals and young rebels alike were meanwhile telling anyone who would listen that there is something wrong throughout the giant Department of Health, Education and Welfare. Desegregation, civil rights, student unrest and now violence—the list of complaints became so long and din so loud that Secretary Robert H. Finch, the Administration's lone stranger, scheduled an unprecedented face-to-face meeting with his Department's employees. As of this writing, he had been unable to keep the date. He went to Walter Reed Hospital instead, and there were rumors (since confirmed) that his old friend, Dick Nixon, might rescue him by appointing him to a White House staff job.

The complaints about health are high on the list. Without question, there are deep dissatisfaction and anger in health agencies, among both the bioscientists and those who deliver or try to improve health care. Among the troubles are:

◇ Injection of what is rightly described as "naked politics" into hirings and firings in medical and health fields.
◇ Acute lack of funds. Health and particularly mental health (projects, research, training) have been among the most severely hit areas in Johnson and Nixon anti-inflation budgets.
◇ "Even worse," according to the complainants, lack of interest. Dr. John Knowles, Director of Massachusetts General Hospital, says: "I don't think the voice of health is being heard very clearly. I don't think the President gives it a very high order of priority."

An exodus of bright division heads and deputies has begun. Far worse, many medical school deans now speak of "nearly five years of research and training holdbacks and cuts," followed by more such years ahead, probably, before these policies are reversed, followed by several years of new build-up. They say all this will mean that a whole generation of potential health scientists, teachers, and medical specialists inevitably will be lost.

"People Began Getting Phone Calls"
The current focus on unhappiness in health fields began with the resignation May 8 of Dr. Joseph T. English, a bright Washington operator and psychiatrist who headed H.E.W.'s Health Services and Mental Health Administration. Dr. English was plainly invited to resign; the pressure came neither from Finch nor from Dr. Roger Egeberg, Assistant Secretary for Health and Scientific Affairs, the top government doctor. It came from the White House, where the main problem seemed to be that Dr. English was a Democrat. Promptly on his resignation, his job was removed from the Civil Service rolls and made appointive.

Dr. English's successor, Dr. Vernon Wilson, Director of Health Affairs at the University of Missouri, "has no discoverable politics," according to a Missouri congressional source. At any rate, he was considered acceptable—a problem, to be sure, to an Administration faced with the fact that most government health professionals and health scientists happen to be both Democrats and liberals, just because these have long been the kind of persons most likely to seek health activist or bioscience jobs.

When the news of Dr. English's resignation and the facts behind it were publicized, one high-level official reported, "People began getting phone calls from on high, and tender care. We've seen appointments going through in the last few days after hanging fire since November."

In a more basic sense, however, said the same person: "The politics is getting more naked. I can assure you there has never before been the political check there is now—down to the GS14 level." (GS14s begin at $19,643 or more.) Appointment of a new Director of Mental Health Services, Dr. Claude Thomas; nomination of Dr. Morris Chafetz of Boston as Director of Alcoholism; a search for a new Mental Health Training Director—all have had careful political checks.

"There is screening of scientific appointments throughout H.E.W.," said another official in full position to know. "It is stated Administration policy to appoint as many Republicans as possible." Or if you can't find a Republican, at least find a neutral or not-too-troublesome Democrat.

Dr. English's will not be the last ouster, according to the high-level rumor mill. According to this channel (often but not universally right), both Dr. Stanley Yolles, Director of the National Institute of Mental Health, and Dr. Robert Marston, Director of N.I.H., are "slated to go inside of months." (Added in proof: This was an overestimate; Dr. Yolles resigned under fire June 2.)

N.I.M.H.: National or Local?
Dr. Yolles made the Administration shipping-out list for at least three reasons: he courageously testified and prevailed for a moderate penalty structure on marijuana and narcotics, as opposed to harsher Justice Department policy; he equally courageously opposed much of an ongoing decentralization of N.I.M.H. activities into regional offices; and he or aides helped get both House and Senate to insert into N.I.M.H. legislation last year a veto power for the National Advisory Mental Health Council—an expert and citizen group—over newly decentralized regional decisions in one of N.I.M.H.'s showcase programs.

This is the program that starts and helps support community mental health centers: local clinics to give emergency and day care and help reduce mental hospital populations. President Nixon last year ordered that as many federal programs as possible be turned over to "grass-roots" direction. An H.E.W. task force under Deputy Under Secretary Fred V. Malek is working hard and fast at the job. It sees putting mental health centers under H.E.W.'s ten regional directors as "more effective administration," closer to the people who are served.

But the program's directors at N.I.M.H. (who, after all, have put together a generally successful effort; by July 1, 490 community mental health centers will have been funded) see the change as "just a power play" to put the centers under real control of the nonmedical often politically appointed regional directors, men close to state and local patronage and pressures.

Despite N.I.M.H. opposition, mental health center construction decisions were regionalized March 31; staffing is to be regionalized July 1. The highly disturbed advisory council thinks regionalization of N.I.M.H. training grants may be next; Finch denies it; a confrontation is scheduled.

Certainly, Dr. Yolles notes, if you take away mental health centers and training, N.I.M.H. is left as an agency with research grants (now about $87 million a year) and a few other smallish programs (like narcotics treatment). It will in effect have been dismembered. It is an agency that until now has had a high degree of strength and independence, a degree that mental health professionals believe is vital, because "no one else really believes in mental health—put it under any one else's direction, and it's always funded last and least."

All these health troubles began with Finch's failure to win backing for the appointment of Dr. Knowles as his Assistant Secretary for Health. Dr. Egeberg, who wound up with the job, has been no barn-burner; perhaps, given the circumstances, no one could be. Dr. Egeberg openly blames White House aides and not Finch.

"You Haven't Seen Anything Yet"
A year ago Dr. Jack Weinberg, director of the Illinois Neuropsychiatric Institute, was asked to serve on an advisory committee on aging. Then he was asked about his politics. "I said, 'I worked for Senator McCarthy,' " he reports. He was not appointed.

Given political screening in health fields, given Vietnam, given many disappointments, says one department head, "I'd predict you haven't seen anything yet in the way of rebellion."

Victor Cohn, who writes regularly for Technology Review, *is Science Editor of the influential* Washington Post.

National Report
Victor K. McElheny

New reports from the spring meetings of the American Geophysical Union and the National Academy of Sciences confirm that "this is not primarily a theoretical time for the sciences of the moon. It is a time of heroic empiricism. . . . It is a latter-day equivalent to looking through the first astronomical telescope."

The Moon: A Hurricane of Facts

The next moon mission—Apollo 14—will go right back to the Fra Mauro target which Apollo 13 missed. Scientists are pleased by N.A.S.A.'s decision: they are convinced that every lunar landing is a step toward the day when scientists themselves will be able to walk on the moon and do a more leisurely, ruminative exploration of the earth's companion museum of planetology, and so they are eager for every moon landing they can get; they were terribly disappointed to lose significant experiments from Apollo 13; and lunar samples from the Sea of Tranquillity (Apollo 11) and the Ocean of Storms (Apollo 12) have produced such a fascinating jumble of data that a visit to a different province, such as that of Fra Mauro, is keenly anticipated.

(Apollo 14 cannot take off before December 3; its original date was October 1. The oxygen tank whose explosion put the astronauts of Apollo 13 in their very public danger must be redesigned. On May 27, a N.A.S.A. review board announced a tentative conclusion that the explosion was caused by the failure of two small switches designed to protect heaters in the 26-inch sphere from overheating, and vaporizing insulation that could "burn" with the oxygen and cause a violent increase in pressure. The failure might have been caused during countdown work just before takeoff.)

Fra Mauro is presumed to consist of debris cast up by an immense meteorite collision which presumably formed the basin of Mare Imbrium—the Sea of Rains—early in the moon's 4.6-billion-year history. There is a good chance that a visit to Fra Mauro will turn up rock samples considerably older than the age of 3.65 to 3.4 billion years now calculated for, respectively, the Sea of Tranquillity and the Ocean of Storms.

A First-Class Lunar Brain-Teaser

Apollo 11 results reported at the Lunar Science Conference in Houston last January showed that rock samples returned from the Sea of Tranquillity crystallized about 3.65 billion years ago—with two exceptions. One was the unique so-called Luny Rock which Professor Gerry Wasserburg of the California Institute of Technology (who somewhat hysterically refers to his laboratory as "The Lunatic Asylum") placed at 4.3 billion years. The other was rock 12,013, picked up on Apollo 12, which has turned out to be chemically different from all other moon rocks and to be 4.6 billion years old—as old as the oldest meteorites. Wasserburg announced this date at an international conference in Leningrad May 26. The dust from Tranquillity Base was placed at about 4.5 billion years old. The clear indication was that the moon had not only accreted from materials already chemically differentiated with respect to both the earth and the meteorites known as chondrites but also had undergone a considerable episode of internal melting.

By contrast, less than a month after the return of Apollo 12, studies led by Oliver Schaeffer of the State University of New York at Stony Brook indicated that rocks of the Ocean of Storms had last crystallized between 500 million and 1 billion years later than those from the Sea of Tranquillity; the Apollo 12 results hinted at a moon which had been hot for the first 2 billion years of its history.

But just two months ago, at the annual meeting of the American Geophysical Union in Washington, Professor Wasserburg put the age of the Ocean of Storms rocks back at 3.4 billion years and dust samples from the Ocean of Storms at 4.4 billion years old—a lot older than the rocks, only a fraction of them conglomerate breccias, lying in the dust.

At first look, all this simply doesn't seem to add up. Studies in many laboratories provide evidence of much churning of the moon's near-surface "regolith" over millions of years. Isn't the dust derived from the rocks lying in its midst, the erosion caused by meteorites bombarding the moon's unshielded surface? It would appear not. Instead, the rocks were last crystallized 1 billion years after the presumed formation of the moon some 4.6 billion years ago. How these rocks, which may represent lava from within the moon filling the cratered basins of the "seas," later came into association with dust which dates back near the creation of the moon is a first-class brain-teaser for those riding the hurricane of facts from the moon. It is a puzzle which lunar scientists may simply have to live with until the gradual accumulation of data from the moon begins to make sense.

James R. Arnold of the University of California at San Diego, reviewing the evidence at the annual meeting of the National Academy of Sciences in Washington, said the Luny Rock—the 4.3-billion-year-old sample from Tranquillity Base—could be a sample of the Adirondack-type anorthosite mineral which John Wood of the Smithsonian Astrophysical Observatory proposed, with surprisingly little contradiction, for most of the lunar highlands. Anorthosite (presumably cast down to the lunar seas from nearby highlands) and meteoritic fragments make up small fractions of the dust.

Hence the interest in samples from the Fra Mauro (uplands) landing.

The Moon's "Lively" Period

Discussing their new evidence for last crystallization in the Ocean of Storms some 3.4 billion years ago, Professor Wasserburg and his co-workers conclude that "there was a widespread outpouring of lavas over the mare (sea) regions in a relatively narrow time interval about 3.5 billion years ago. This must represent," they said, "a major episode of physical and chemical differentiation of the moon." It raises questions: Was there only this one period of major activity, or are there other mare regions whose rocks will be of very different age? If there are no younger episodes, what mechanism could have cut off the melting so suddenly? What were the energy sources for the processes, however distributed in time? Wasserburg reaches one firm conclusion: "We know that the moon certainly was not stillborn 4.6 billion years ago but had a fairly lively existence between 3.4 and 3.7 billion years ago."

These findings gain interest from the fact that the oldest rock samples discovered on earth, from South Africa, are 3.3 billion years old. Is it possible that the moon and earth may have shared some catastrophe in that epoch?

Sending Science to the Moon

While earthbound scientists continue to examine lunar samples, experiments placed on or near the moon, with and

without a man's hands to help, provide increasingly important information. Now that astronauts have visited the neighborhood of Surveyor V (on Apollo 11), we have samples which confirm the accuracy of the remote-controlled analyses from the alpha-particle back-scattering instruments placed on the moon by Surveyors V, VI, and VII. The Surveyor VII results are of special interest.

The University of Chicago group under Anthony L. Turkevich suggest that the lunar highlands, covering 80 per cent of the lunar surface, are analogous to the continents covering 25 per cent of the earth. But Surveyor VII, which landed at a highland site near the north rim of the crater Tycho, reveals that the lunar highlands—in contrast to terrestrial highlands—are not enriched in silicon and sodium and depleted in magnesium with respect to the mare regions (which can be viewed as analogous to the basaltic sea-bottoms on earth), even though both the terrestrial and lunar highlands are depleted in such heavy elements as iron and titanium. If the whole moon were made of highland material, it could not be compressed in the interior in such a way as to yield the known overall lunar density of 3.36 times that of water; the Chicago workers believe the highland material has density of only 2.96 times that of water.

This leads Turkevich and others to argue that Surveyor VII provided "the first direct evidence for chemical differentiation on the moon as a whole." They conclude that "the chemical data suggest that the (highlands) constitute a crust that is distinctly different chemically from the interior of the moon."

Hence further interest in what Astronauts Alan Shepard and Edgar Mitchell bring back from their Apollo 14 expedition to the hills of Fra Mauro. Will it be material like that near Tycho, or something else again?

Impact Seismology

The single scientific success of Apollo 13 was the planned crash of the S 4-B upper rocket stage onto the moon just 76 miles west of the seismometers left behind by Apollo 12 astronauts Charles Conrad and Alan Bean. Already those instruments had recorded a peculiar ringing in the lunar interior which took seven minutes to reach its peak and another 48 to tail off after the impact of the discarded upper stage of the Apollo 12 lunar landing craft Intrepid. (The same type of signal is also characteristic of natural events which have followed at the rate of about one a day. The best guess at the moment is that all these natural events are the impacts of meteorites weighing up to a few kilograms, each striking the moon within 200 miles of the instrument.) The near-vertical crash of the S 4-B rocket caused seismic signals which built up for ten minutes and took four hours to tail off.

From this, scientists of the seismometer project, led by Gary V. Latham of the Lamont-Doherty Geological Observatory of Columbia University, have concluded that they can't be dealing with a simple rubble pile and that the material of the lunar surface represents what is underneath, at least to a depth of 13 to 25 miles. Laboratory work on compressing Apollo 11 samples, done both at M.I.T. and the Lamont-Doherty Observatory, helped confirm this conclusion.

Now scientists concerned with the seismometer project, including Frank Press of M.I.T. and Maurice Ewing, the Director of Lamont-Doherty, believe the seismic techniques can be considerably extended—that objects can be impacted on the moon at increasing distances from the seismometers, leading to echoes from deeper and deeper within the moon's interior.

But the scientific station left at the Ocean of Storms by Apollo 12 is designed to operate only for a year—a period which will have passed before Apollo 14 can be launched. So there may be no seismometer on the moon to record the crash of the Apollo 14 upper stage, and the hope of having the Apollo 12 and Apollo 14 seismometers subsequently work together may not be realized. Hence the acute disappointment in the scientific community at the failure of Apollo 13.

Moon Magnets, Solar Wind, and Continental Drift

Three flux-gate magnetometers designed by a team under Charles P. Sonett of N.A.S.A.'s Ames Research Center were left on the moon by Apollo 12; they were designed to work with magnetometers aboard the Explorer 35 satellite now in lunar orbit, which detect no lunar magnetic field. The magnetometers on the lunar surface have recorded a "remanant" magnetic field of about 35 gammas, about .001 of the field at the earth's surface. Sonett reported at the A.G.U. that—were that source a small bar magnet—it would be some 125 miles from the instruments.

Comparison of the solar wind measured by Explorer 35 magnetometers with magnetometers on Explorer 33, which was supposed to take up a lunar orbit but instead is in an eccentric earth orbit, has yielded for Norman F. Ness of Goddard Space Flight Center a measure of the electrical conductivity of the moon's interior and hence of its temperature. Ness calculates a temperature between 900° and 1,600°F., a figure even lower than that claimed by such enthusiasts of the "cold" moon as Harold Urey.

The laser reflector left behind by Apollo 11 continues to work well, Carroll O. Alley reported at the A.G.U. The idea of this experiment is to use the reflected laser beam to refine measurements of the distance between places on the earth and the Sea of Tranquillity. Over a period of about ten years, such refined measurements should show if there are minor wobbles of the earth and the moon around their axes, and possibly continental drift on earth. To improve the prospect of good continental drift measurements, Professor Alley reported at the A.G.U., he is seeking to have astronomers in Hawaii and Japan, between which the continental drift is presumed to be most rapid, install lasers. Meanwhile, French astronomers have measured laser beam returns from the Sea of Tranquillity, and Russia has been making the attempt from its 102-inch Crimean telescope.

A Precipitate from a Sandy Atmosphere

The large number of new results from the moon continues to undermine traditional ideas of the moon's origin—by capture, by simultaneous formation in the earth's vicinity, or by fission from the earth. Now the proposal made by A.E. Ringwood, the Australian scientist, back in 1966 is gaining new interest; he postulated that the moon precipitated out of a thick, sandy "atmosphere" surrounding an Earth whose core had just begun to form. Ringwood bases his arguments on geochemical grounds, and the theory seems to fit many of the chemical findings from the Sea of Tranquillity. Professor A. G. W. Cameron of Yeshiva University—a much-respected lunar scientist—arrives at practically the same theory on astrophysical grounds as part of a general notion of how the sun and its system of planets might have formed in a very short time out of gaseous, galaxy-like nebula.

But this is not primarily a theoretical time for the sciences of the moon. It is a time of heroic empiricism. Fresh winds are blowing through an open window. It is a latter-day equivalent to looking through the first astronomical telescope. Although Galileo might have been astonished to see any important new information emerging from so structured an effort as the American moon program, there is no question that he would be delighted to be alive to see the new world take shape.

Mr. McElheny is Science Editor of the Boston Globe *and was formerly European Correspondent for* Science; *he contributes regularly to* Technology Review, *and faithful readers will be aware of his enthusiasm for the adventure of lunar and space exploration.*

Representative John W. Davis, who is an odds-on favorite to hold Chairman Daddario's post on the House Subcommittee on Science, Research, and Development in the Second Session of the 91st Congress, claims "an abiding interest in where science is going." Mr. Hall concludes that "the best interests of science will be supported under his judicious guidance."

A Star-Gazer Rising

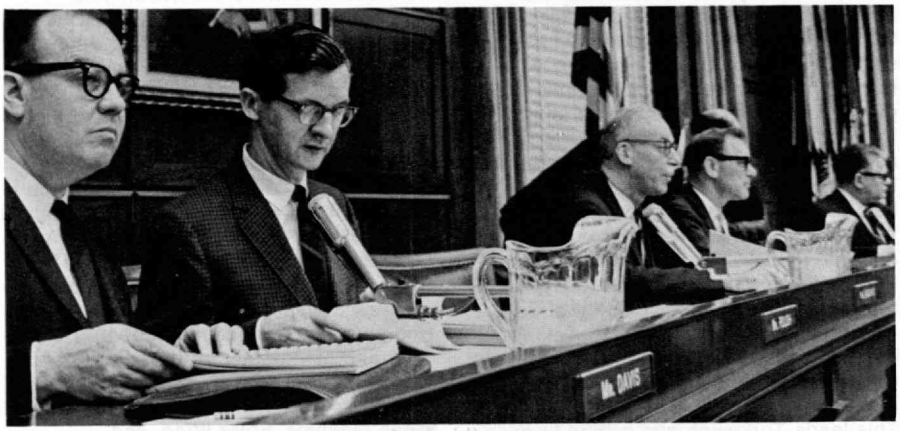
Better perhaps than any other adjective, judicious describes the character of John William Davis who, for the past decade, has represented more than a half-million folks who live in the Seventh Congressional District, largest in the State of Georgia. Small wonder—he was trained as a lawyer, practiced law for many years, and served for six years as judge of Lookout Mountain Judicial Circuit before he was elected to the House of Representatives 10 years ago. He's still there, and probably will be when all the votes are counted in November.

Thus almost without question he will be on hand to succeed Emilio Daddario (an announced candidate for Governor of Connecticut) as Chairman of the influential Subcommittee on Science, Research, and Development of the House Committee on Science and Astronautics. And unless all omens and portents deceive us, Davis's juridical nature will probably serve science well.

You learn, on talking with him, that Congressman Davis' interest in science began at an early age when he wisely anticipated the growing impact of science and technology on the economy of the future. Quite literally, he's a star-gazer, an amateur astronomer who not infrequently searches the skies with his own telescope. Long before he came to Washington, he had subscribed to *Scientific American,* and he still reads it avidly. The merits of such early staff work show up in searching questions Congressman Davis asks of witnesses who appear before the Daddario subcommittee. A rundown of past hearings discloses Davis' alert attention to the testimony of pleaders of the cause of science-technology, and a perceptive knowledge of substance.

"I'm not a scientist," Representative Davis disclaims, "but I have an abiding interest in where science is going. I am very much disturbed about the shortage of support funds now going to sustain basic research, and I propose to try to do something about it, assuming that I succeed Mr. Daddario."

Davis doesn't say much. He examines you levelly as you sit talking to him. You begin to feel much like witnesses must have felt in his courtroom. You ask a question; he answers it—period. At some point, however, he seems to have made up his mind about you. Maybe, after all, you're being straightaway about the interview, not seeking to box him in, nor lead him down a twisting road. Unexpectedly, and disarmingly, a warm, Georgia smile greets your efforts and quietly he begins to respond.



The House Science and Astronautics Committee hearings on the Apollo fire in 1967. Rep. John W. Davis (far left) *is a likely successor to Rep. Emilio Daddario as chairman of the Subcommittee on Science, Research, and Development.*

"I'm not entirely a stranger to this business, you know," he says. "I've been chairman of the Subcommittee on the National Bureau of Standards for some time. I have also been for some time the senior member of the Subcommittee on Science, Research, and Development. I've learned much in those years about this nation's concerns for a progressive posture for science and technology. One of the most productive interchanges takes place every year when our panel of experts meets with the subcommittee members for a three-day dialogue. It's a splendid forum for each of us non-scientists to listen to what is on the minds of the 16-member panel [including William F. Pounds, Dean of M.I.T.'s Sloan School of Management], representing the finest science-technology thinking in the United States. I thoroughly enjoy my association with these men and the constituencies they represent."

But then a note of political realism begins to inhibit the discussion. Congressman Davis will have opposition in November, but he's been opposed before. He enters the competition confidently, but modestly. "I've got to be re-elected, you know, before I can talk too much about what I plan to do in the interests of science," he points out.

On the other side of Pennsylvania Avenue in Washington, nearly every leader who must annually present his case for science on Capitol Hill hopes that the good people of the Seventh District of Georgia will send Congressman Davis back to Washington. The odds are that he will be a worthy successor to Emilio Daddario, and that the best interests of science will be supported under his judicious guidance.

Clyde C. Hall, former Public Information Officer for the National Science Foundation, is now a free-lance science writer in Washington; his comments appear frequently in Technology Review.

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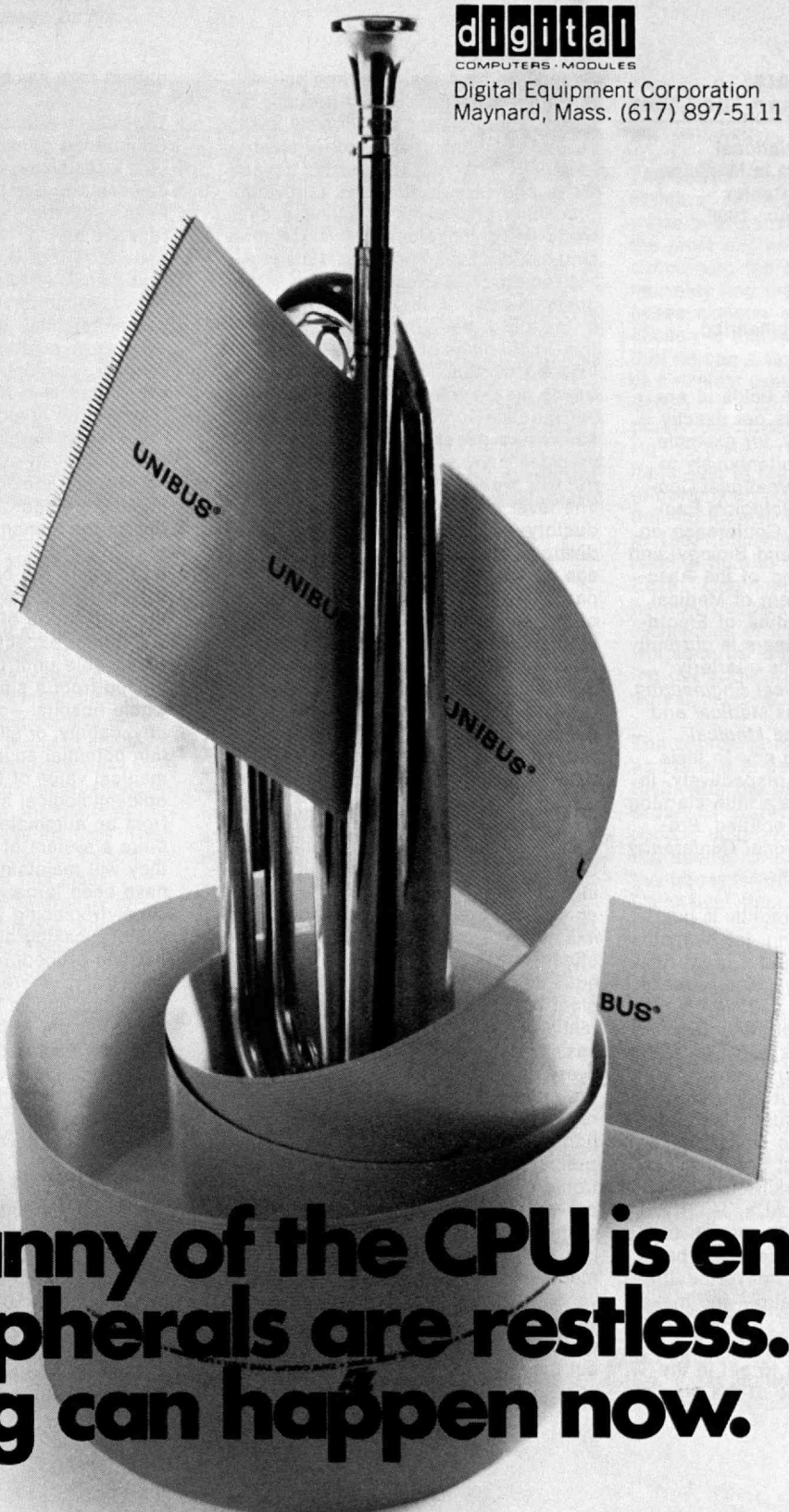

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Elixirs Ancient and Modern

Doctors and Computers: Each Less Perfect Than The Other

Proceedings of the First National Conference on Electronics in Medicine, Electronics Management Center
New York, McGraw-Hill, Inc., 1969,
212 pp., $14.50

Reviewed by
William M. Siebert
Professor of Electrical Engineering
M.I.T.

The interaction of various fields of engineering with medicine is not exactly a brand-new idea. Last July, for example, Chicago played host simultaneously to the Eighth (biannual) International Conference on Medical and Biological Engineering, the 22nd Annual Conference on Engineering in Medicine and Biology, and the Fourth Annual Meeting of the Association for the Advancement of Medical Instrumentation. The Institute of Electrical and Electronics Engineers is currently publishing Volume 17 of the quarterly *Transactions on Bio-Medical Engineering,* and other journals such as *Medical and Biological Engineering* and *Medical Research Engineering* are now in their seventh and ninth years respectively. In this historical context it is a little startling to encounter a new book entitled, *Proceedings of the* First *National Conference on Electronics in Medicine.*

On second thoughts, such a title is not, perhaps, so very surprising, for biomedical engineering is attracting a great deal of new interest these days. The reasons are obvious enough. Our national "non-system" for the delivery of health care is clearly in a state of disarray, while at the same time funds for military research and development are being cut back. Our technologically based industry is hungry, and the professionals who staff it are increasingly worried about the relevance of their knowledge and skills to something besides A.B.M.'s, L.M.'s, M.I.R.V.'s, and S.S.T.'s. Why shouldn't the clever minds that put a man on the moon be able to figure out how to deliver health care efficiently to the ghetto—and make a profit while doing it?

Everyone has been trying to get in the act; this conference is one of the results. Sponsored by a major technological publisher (McGraw-Hill), it brought together about a year ago in New York several hundred people from industry, hospitals, financial concerns, government, and research centers (individual practicing physicians and the academic world were conspicuously underrepresented) to participate in a "dialogue" between the "medical and engineering communities." In the course of perhaps a day and a half (there is no mention in the Proceedings of *any* dates) they listened to panel discussions on such topics as the role of computers in medical practice; problems of safety, reliability and effectiveness in electronic medical instrumentation; and the "systems approach" to health care delivery. The level of the discussions was introductory—dictated, no doubt, by the diversity of the audience—and the average quality was moderately high. I found particularly interesting a superb survey of the accomplishments and potential of biomedical engineering by Michael DeBakey, the great Houston heart surgeon. In addition, several long papers on safety problems were enlightening, and the panel discussion on "Why can't doctors and engineers communicate?" was both thought-provoking and enjoyable.

Still, the overall impact of this book, as well as much other recent literature in biomedical engineering, is a bit depressing. The cries for help from the medical community are real enough; no one can examine the current statistics on cost or effectiveness of patient care with equanimity. Technology—particularly electronics—equally clearly has the potential for providing at least a degree of assistance; much of the effort in the delivery of health care is concerned with the collection, communication, storage, retrieval, interpretation, and manipulation of a variety of data and records—precisely the sorts of tasks that electronic gadgets and computers have proved they can do so well in accounting systems and the space effort. Why, then, has the impact to date of technology in medicine been so small? To be sure, advanced instruments and devices have yielded much new medical knowledge and have directly helped a few patients, but the contribution of technology to resolving the day-to-day problems of patient care has been disappointing.

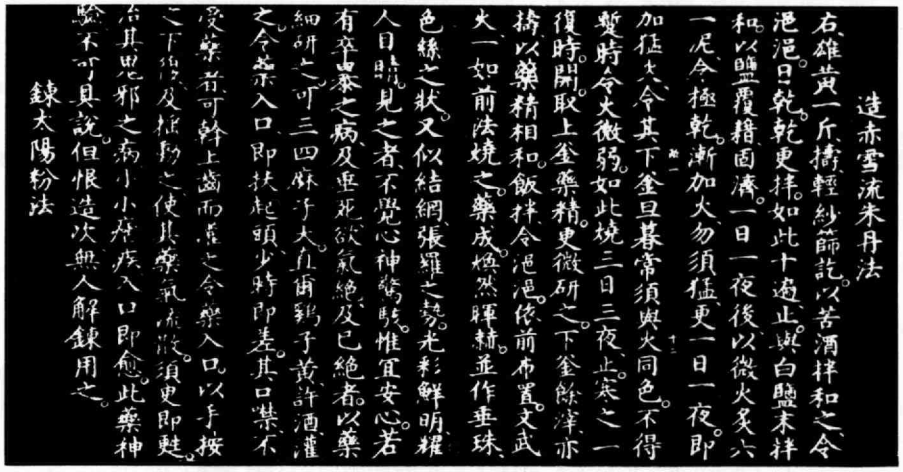
The reason—as several speakers at the Conference pointed out—is basically cost effectiveness. Most of the electronic devices and computerized systems that have been tried are sophisticated, unreliable, hard to use, and extremely expensive. There is little reason to believe that, considering all their side effects, they save the physician or other scarce personnel much time and effort. And there is no evidence to support the hope that, by replacing harassed, careless, or even indifferent humans, machines might improve the quality of health care. Indeed, Leon Harmon—a computer expert—has said elsewhere[1], "Knowing machines and knowing people, each at an imperfect stage of evolution, I tend to opt for the human."

Enthusiasts will be quick to point out that there are severe problems of scale in the automation of medical systems, that we cannot expect per-unit costs to be reasonable until the systems are extended from a single bed or ward to a whole hospital—or even better, to a city, county, or still larger region. Certain potential advantages, such as the medical value of the demographic and epidemiological statistics readily derived from an automated system, clearly require a system of large size. Moreover, they will maintain that, to date, efforts have been largely directed towards simply replacing people with machines without making any more changes in existing procedures than are absolutely necessary, whereas experience in other fields has shown that in the long run major system rethinking is necessary to take full advantage of automation. What is needed, these enthusiasts tell us, is a major commitment of funds and effort to carry medical automation from the research to the development stage.

Perhaps. But the more experienced and responsible members of both the engineering and medical communities believe that we do not yet know enough about the health care delivery problem to

1. Leon D. Harmon, Address before a conference on Automated Multiphasic Health Testing and Services, sponsored by the National Center for Health Services Research and Development, Washington, D.C., Jan. 21-23, 1970

A page from a famous alchemy text of the T'ang period in ancient China. The recipe on the right side of the page was actually carried out by author Nathan Sivin; it is titled, in Chinese, "Formula for Making Scarlet Snow and Flowing Pearl Elixir." Dr. Sivin found that, at one stage, the alchemist following the recipe would produce metallic arsenic. The next step is marred by a dubious passage in the text, but it is possible that the final elixir is crystalline or fibrous arsenic trioxide. The ancient author of the text claims that "those suffering from a fainting attack, those on the point of death, and those who have already expired," will "in a short while recover" and "come to life again" if they take pills made by his recipe.



proceed to large-scale deployment of automation in medicine. Medical care is a complex, sophisticated, intensely interpersonal activity, subject to strong social, political, economical, geographical, and historical influences. It does not lend itself easily to generalization or idealization. And it is extremely difficult to test or evaluate. In the past decade or two, attempts have been made to apply computers to a number of problems—such as air defense, airline reservations systems, electronic telephone dialing—sharing some or all of these features. The results have led J.C.R. Licklider to conclude[2] that for systems of this class "costs and times tend to be grossly underestimated and performance tends to be mercifully unmeasured." So far as health care delivery is concerned, it remains to be seen whether automation in particular (or, indeed, technology in general) is part of the problem or part of the solution.

Further conferences between medical professionals and technologists will no doubt help us to decide. But one suspects that volumes such as the present Proceedings—hurriedly printed and inadequately edited from oral presentations, badly balanced in coverage and depth, lacking both an index and references, and expensive ($14.50)—will not prove very useful.

2. J. C. R. Licklider, "ABM—An Evaluation of the Decision to Deploy an Antiballistic Missile System," Signet Broadside Q4006, 1969

On Alchemists and Chemists

Chinese Alchemy: Preliminary Studies
Nathan Sivin
Cambridge, Harvard University Press, 1968, 365 pp., $15.00

Reviewed by
David Pingree
Oriental Institute
University of Chicago

In this excellent study, which most auspiciously inaugurates the new series of *Harvard Monographs,* author Nathan Sivin greatly expands our understanding of the chemical processes employed by Chinese alchemists. Moreover, he presents an outstanding example of the type of rigorous criticism which must be applied to available historical documents relevant to alchemists and other Taoists before they can yield reliable data on the people involved and their work.

The core of Sivin's book is a critical edition of the *Tan Ching Yao Chueh,* traditionally ascribed to Sun Ssu-mo, a famous adept of the T'ang period. This is preceded by an English translation accompanied by notes that define the substances employed in terms of modern Western chemistry and botany, and the diseases to which reference is made. The justifications for these identifications are given in two appendices, while a third provides a bibliography of secondary sources in Chinese, English, French, German, and Japanese on Chinese technical terms in chemistry and pathology.

The author considers this work "preliminary" in the sense that, as a necessary prerequisite for understanding the more esoteric teachings of alchemy concerning the achievement of immortality and the close relationship between alchemy and medicine, he has chosen to explicate to the fullest extent that he can a text providing a collection of chemical prescriptions, thus elucidating more fully than ever before the purely practical aspects of the art. He has gone so far in this direction that he is able to report on an experiment (unfortunately somewhat inconclusive) that he himself carried out in Singapore in 1962 following the "formula for making Scarlet Snow and Flowing Pearl Elixir." One hopes that the firm basis he now possesses in the operational techniques of the Chinese alchemists will soon be applied by Sivin to furthering our knowledge of their other procedures.

The choice of the *Tan Ching Yao Chueh* as the text to be translated also provided Sivin with the more traditional historical problems of dating and authorship. His second chapter deals in detail with the special problems connected with the transmission of alchemical texts in China and their chronology and attributions. All possible criteria are examined, but it proves possible only to conclude that the traditional attribution to Sun Ssu-mo is possibly correct. In the next chapter Sivin probes the biographical tradition concerning Sun; everything melts before his critical gaze save the fact that "Sun was in the Emperor's retinue in 673, and stated at that time that he was born in 581." Would that such rigor were evident in the writings of other historians of science and not by any means only those of Chinese science!

As his last appendix Sivin lists the 13 other Chinese alchemical texts which have been translated into English. His present contribution is a worthy continuation of the work of Tenney Davis, his predecessor at M.I.T., and of that of Ho, Needham, and Ware.

A Quick but Unsure Grasp of Solid-State Electronics

The New Electronics
Bruce H. Shore
McGraw-Hill, 253 pp., $10.00

Reviewed by
David Adler
Assistant Professor of Electrical Engineering, M.I.T.

The New Electronics is advertised to be "a simple yet highly informative guide to electronics, from the invention of the transistor in 1948 to the very latest advances in holography, lasers, and artificial intelligence. Literate, impressionistic, metaphorical, and above all, nontechnical, this book offers a quick but sure grasp of solid-state electronics and the materials and phenomena associated with it." This is a tall order for any book to fulfill, but few would deny the need for even a partial success in explaining recent solid-state advances to the layman.

Unfortunately, *The New Electronics* does not succeed, although it certainly goes down in flames. In its relatively few pages, it takes on an astonishing number of topics, all of which focus on the incredible rate of progress in the last 20 years. Here, laid out in front of us, are transistors, computers, lasers, superconductive magnets, holography, field-effect transistors, MOS devices, Gunn-effect oscillators, tunnel diodes, electroluminescent displays, acousto-electric detectors, avalanche diodes, liquid-crystal screens, xerography, artificial intelligence, magneto-optics, integrated circuits, masers, pulse-code modulation, electro-optics, millimeter waves, and hundreds of others. One cannot fail to be impressed by what man has wrought.

But books are not justified by chapter headings alone, and we must rate one such as this on how well it explains the physical concepts on which these devices are based. In *The New Electronics,* the explanations are generally quite poor indeed. Many technical terms are continually used, but are basically undefined; these include coherence, rectification, scattering, dangling bonds, polycrystalline materials, polarization, bits, epitaxy, etc. Sometimes, a pseudo-definition is used, as in identifying van der Waals forces as "weak electrical attractions between molecules, whose existence won their discoverer, Johannes van der Waals, the Nobel Prize in 1910." This should not be very satisfying to one who wants to find out about van der Waals forces.

As in all books for the layman, this one relies heavily on analogy and metaphor. Here the author does have a flair for the imaginative. Few clichés, such as the comparison of an atom to the solar system, appear on these pages. Instead, electrons and holes are the Adam and Eve of solid-state physics, free electrons move as dust through a light ray, plasmas bounce around like silly putty, guerrilla bands of physicists conduct raids across the frontiers of knowledge, superelectrons are partners locked in an ultrasonic embrace. Some of the metaphors are excellent, such as the reference to diffraction patterns as the fingerprints of matter, but others, e.g. the description of holography as a stunning feat of cryptography in which scientists have cracked the phase code of light, are, at best, misleading.

Very often, figures of speech take the place of physical explanations, even when the concepts involved are not beyond nontechnical readers. Thus, crystals are described as catacombs, labyrinths, jungle gyms, but never periodic arrays of atoms. Ferromagnets, antiferromagnets, and ferrimagnets are discussed in terms of atomic soldiers in a parade square, but a sketch of the various spin alignments never appears. Pictures can be worth thousands of metaphors, but not once is a picture used for this purpose. This is not to say that the book is without illustrations. In fact, quite the reverse is true, but the pictures are photographs of the devices being discussed, often artistic, and usually dominated by a close-up of a section of the face of an investigating scientist. This has the advantage of humanizing the technological advances in a relatively subtle way, and I was particularly fond of the photographs of two theorists at work with their pencils and pads, Dwight North near a two-foot stack of unread journals, and Murray Lampert being observed by a large classical bust purchased on one of his trips to Greece.

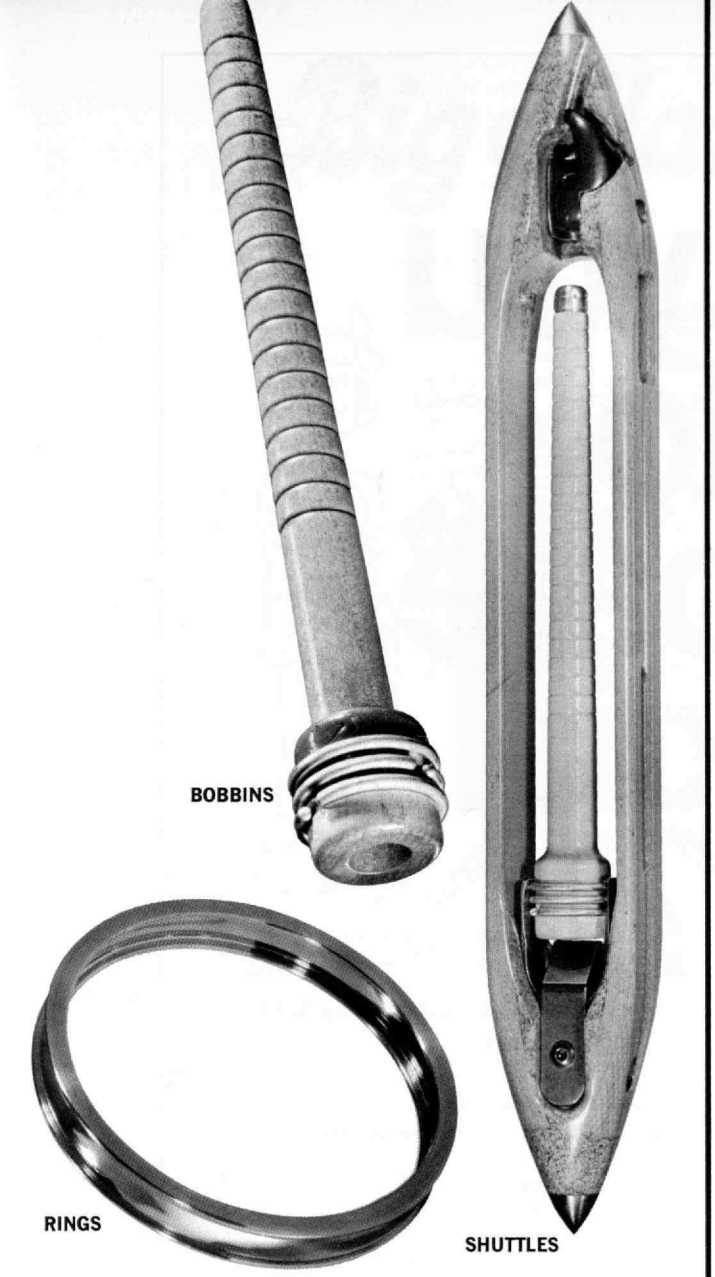
Sprinkled in with the figures of speech are many puns, several overworked, such as the failure of electronic films to win Oscars, but some amusing, as the hope that millimeter waves may prevent communications transmitters becoming "towers of babble."

The biggest drawback of the book is its large number of meaningless and even incorrect statements. Paramagnetism is not a dilute kind of ferromagnetism, phonons are not high-frequency sound waves, surface states are not tiny architectural aberrations that develop as the surface is formed. It is misleading to state that all shadows are caused by destructive interference between light beams which have bent around an object, that resistance is a manifestation of sound energy oscillating through a material at frequencies too high to be heard, or that all visible light is produced by electrons. In an analysis of the Davisson-Germer experiment, it is noted that the fact that the electron beam was diffracted instead of scattered proved that electrons have both particle and wave properties, a statement as useless to laymen (who are ignorant of the definitions of diffraction and scattering) as to physicists (who are ignorant of any difference between the two terms).

We are thus faced with the question of whether or not the book has any redeeming virtues. My feeling is that it does, in one sense. Scattered through its pages is a good history of the march of science from the time of Thales of Miletus, 2,600 years ago, to the present, especially with regard to the technological advances achieved during the last 20 years. Every accomplishment is traced back to the original idea, and this provides a good perspective of the preposterous tide of recent research and development.

Appearing with this are also many predictions of wondrous things to come in the near future. But there is even a historical defect. Recent advances are unfortunately weighted with a large overemphasis on developments at R.C.A., as compared with those at other industrial laboratories or at universities, although this is perhaps understandable when it is observed that the author is Administrator of Scientific Information at R.C.A. and that the book is based on articles written for *Electronic Age,* the R.C.A. magazine. But, for example, the impression is given that the ferrite core memory is essentially an R.C.A. achievement with just a passing note that an M.I.T. group independently solved a part of the problem—a view that few outside observers would share.

In short, this is indeed a "literate, impressionistic, metaphorical, and above all, nontechnical" history of modern electronic advances, but it is also misleading, inaccurate, and provincial.



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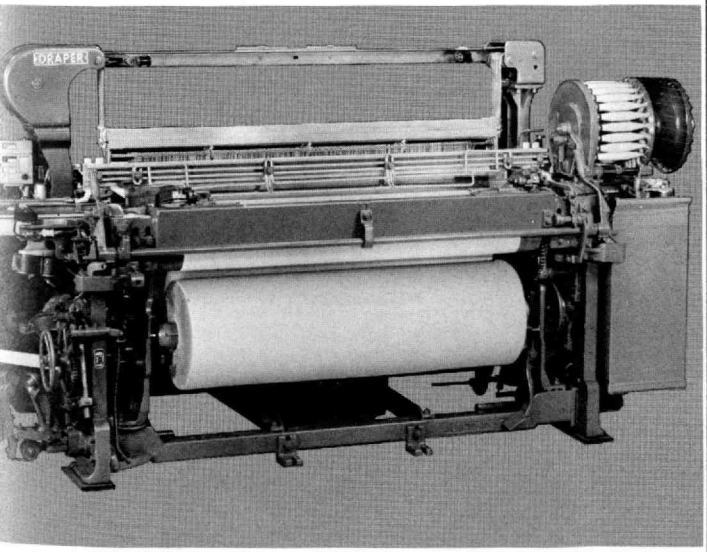

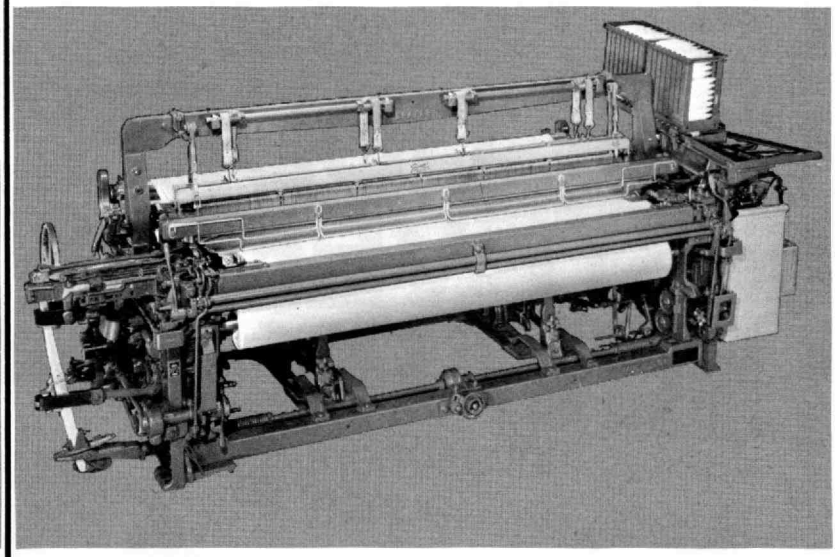

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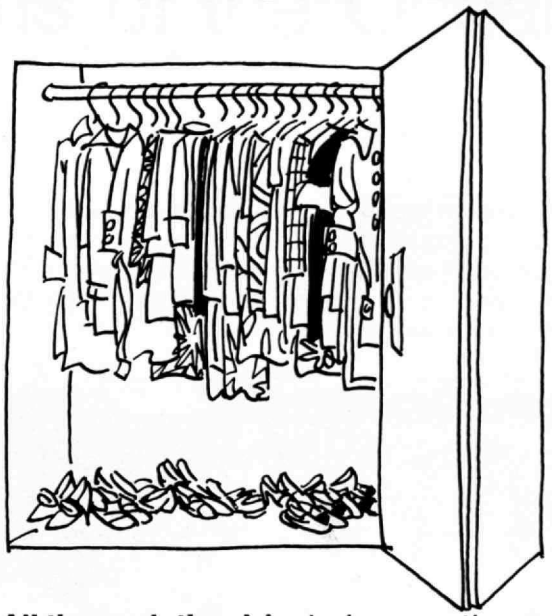

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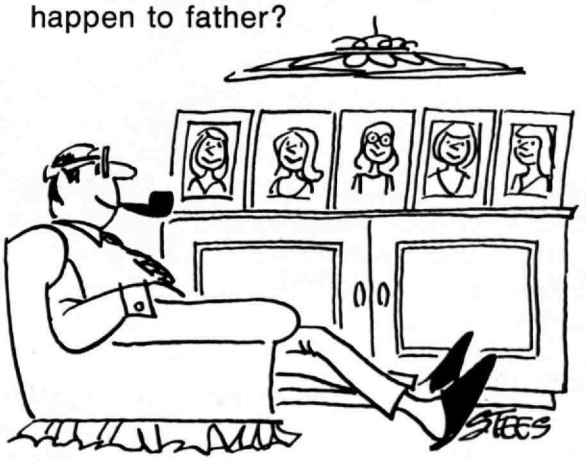

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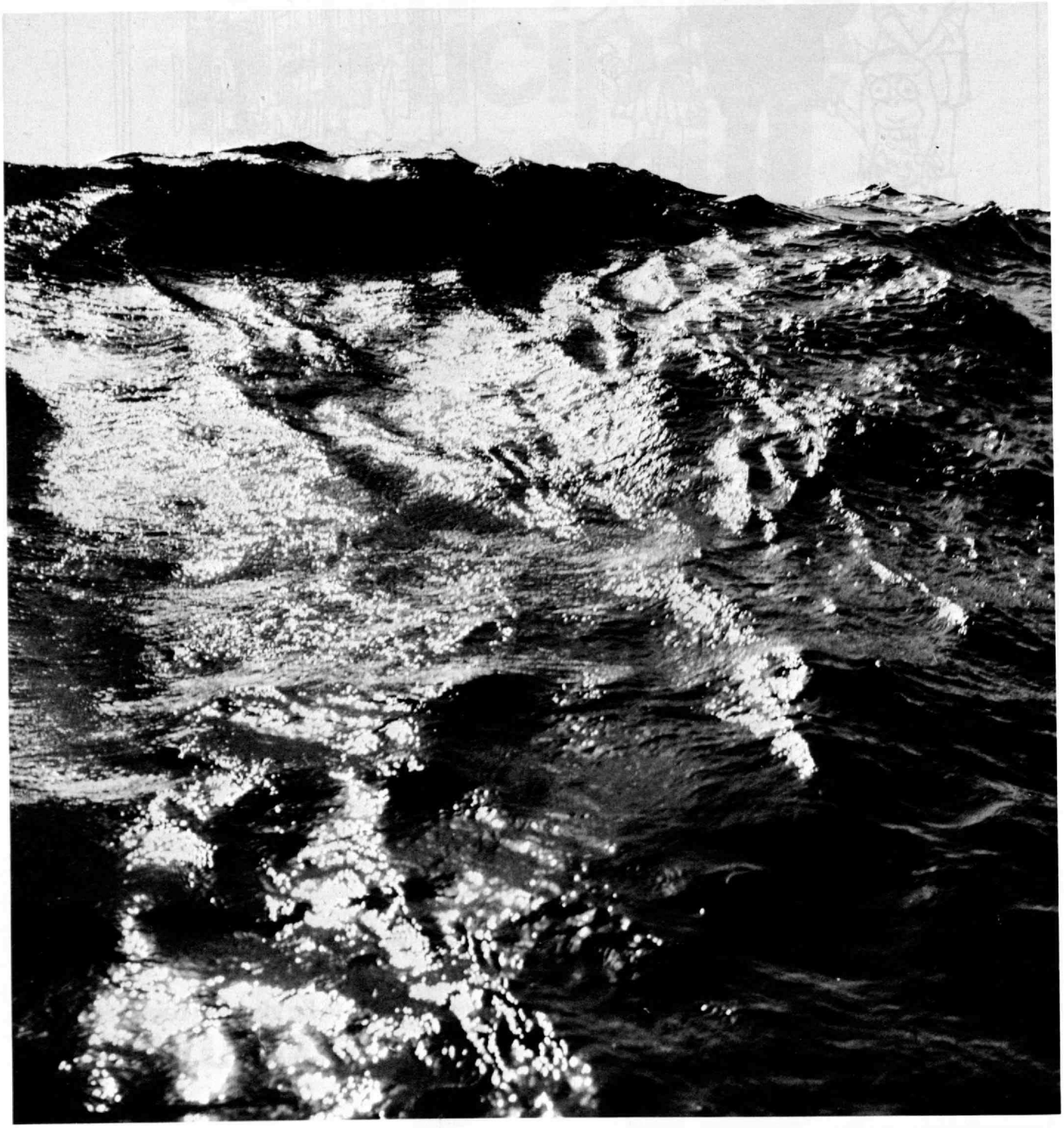
The ocean has always seemed invincible and supremely powerful. It has commanded affection as well as fear. But now, man may have found an ignoble way to best it (Photo: Jan Hahn)



The ocean was once thought to be capable of mastering all that it received. New techniques of analysis of its waters are being developed just in time to show that it is not

Edward D. Goldberg
Scripps Institution of Oceanography
University of California, San Diego

Chemical Descriptions of the Oceans

Understanding his environment has always been a preoccupation with man. We are just terribly curious about the nature and reactions of our surroundings. As a result of such concerns, our natural sciences have evolved. Environmental descriptions have reflected not only the concepts and techniques of the times that made them, but also the social and economic involvements of man with the domains of nature. The ways in which the chemical composition of the ocean has been recorded amply illustrate this thesis.

A rewarding point of departure may be found in the writings of Robert Boyle, who stated in 1774:

"The cause of the saltness of the sea appears, by Aristotle's writings, to have busied the curiosity of naturalists before his time; since which, his authority, perhaps, much more than his reasons, did, for divers ages, make the schools, and the generalitys of naturalists, of his opinion, till towards the end of the last century, and the beginning of ours, some learned men took the boldness to question the common opinion."

This boldness to question took the form of experimentation upon sea waters—investigations which denied that the salts of the sea came from the sun, but were introduced from the continents following wind and water weathering. One of the first chemical descriptions of sea water was presented in 1776 by Lavoisier, with values for the salts sodium chloride, sodium and magnesium sulfates, calcium carbonates and sulfates, and magnesium chloride (see page 26). He recognized the importance of the geochemical role played by water in the main sedimentary cycle with the remark: "Sea water results from the rinsing of the whole surface of the earth."

Modern chemistry developed with the discoveries of the elements. Their concentrations and reactions in natural aqueous systems were very quickly sought. As early as 1822, the chemist Marcet suggested: "For the ocean having communication with every part of the earth through the rivers, all of which ultimately pour their waters into it; and soluble substances, even such as are theoretically incompatible with each other, being almost in every instance capable of co-existing in solution, I could see no reason why the ocean should not be a general receptacle of all bodies which can be held in solution." Today all but about a dozen of the stable elements have been quantitatively analyzed in sea waters. Two elements were initially discovered in the marine environment—bromine and iodine. More recently, the natural occurrences of two cosmic ray-produced radioisotopes, silicon-32 and beryllium-10, were found first in the oceanic domain.

Extracting Mineral Wealth

Simultaneous with the unraveling of the inorganic chemistries of the oceans, the question arose of what species could be extracted profitably from sea water. Although sodium chloride had been removed for use as a condiment for many centuries, a search for other valuable substances was initiated. The classic tale of this phase of marine chemistry involves the proposal of the noted German chemist Haber to alleviate Germany's World War I debt through the extraction of gold from sea water. Initial assays of this precious metal in sea water indicated economic advantages in marine mining over its continental counterpart. Haber's careful work provided one of the early textbook examples of microchemistry, as he was able to analyze gold with high accuracy at levels of 4 nanograms per liter in 2-liter water samples. In one fell swoop his work, published in 1928, reduced the accepted values of gold in sea water by several orders of magnitude (see page 28). Usually a plot of an elemental analysis from a sea water sample as a function of time shows strong oscillations above and below the ultimately accepted value, as for example in the case of bromine (see page 29).

Although today, besides sodium and chlorine, magnesium and bromine are commercially removed from sea water, one of the most important constituents of sea water, worthy of mining, may be the water itself (see tables on page 26).

Food from the Sea

The living organisms of the sea constitute a valuable food source to man, and their potential availability provided the focus for much of the work in marine chemistry during the first half of the twentieth century. The primary production of organic matter by the photosynthesizing plants of the sea yields a food base for the higher organisms.

Marine chemists were able to rank various parts of the world ocean on the basis of their primary productivity, often related to the availability of such nutrient chemical

Chemical descriptions of the oceans may be found as far back as 1776, when Lavoisier published this analysis for a few of its salts.

Water is now one of the components most extracted from the oceans, suggesting that this may, in time, become the ocean's most valuable resource. (Data: "Seawater as a Raw Material," by C. M. Shigley, Ocean Industry, *November, 1968, pp. 43-46)*

Substances	Weight per pound of water, grains
Sodium chloride	126
Magnesium chloride	14¾
Calcium and magnesium chlorides	23
Sodium and magnesium sulfates	7
Calcium carbonate and sulfate	8

Mineral	Tons extracted from ocean per year	Per cent of total production
Sodium chloride	350,000,000	29
Bromine	102,000	70
Magnesium, metal compounds	106,000	61
	690,000	6
Fresh water	142,000,000	—

species as phosphates, nitrates, and silicates. The zones include the open ocean with its relatively unfertile waters, coastal waters with higher levels of plant growth, and finally the areas of upwelling where the nutrients which have higher concentrations at depth are brought to the surface by physical processes. These substances, at concentrations of micromolar and less, were assayed by colorimetric techniques. The development of these methods by the marine workers was at the forefront of analytical chemistry in the 1930's and 1940's. During this period the oceans were often described as a sodium chloride solution containing the nutrient chemicals.

A curious aside involves investigations upon the chemical composition of the marine biosphere, efforts which offered a way of showing the existence in sea water of substances that could not be detected there by existing techniques. The organisms concentrated many of the metals by factors of a thousand or greater over their aqueous surroundings. For example, the Scottish chemist Forchhammer in 1865 found copper, lead, zinc, cobalt, barium, and nickel in living matter but not in sea water. Today the pesticide DDT has been assayed in a variety of oceanic plants and animals, but not as yet in the ocean water, where it must exist in extremely low concentrations.

The Industrial Revolution put more ships to sea and more facilities in harbors. The corrosive actions of sea water upon these constructs of man, composed of a variety of materials, concerned another group of chemists who described sea waters upon the basis of their oxidizing and reducing powers.

Thus, academic curiosity, economic resource, and the destructive nature of marine waters motivated many of the chemical descriptions of the oceans up to the Second World War.

The Nuclear Energy Revolution

New dimensions in marine chemistry were introduced following the developments in nuclear energy during and after World War II, with an increased emphasis upon isotopic analyses of the elements in sea water. The waters of the ocean were no longer to be considered a single species but a mixture of water molecules varying in molecular weight, determined by the particular isotopes of hydrogen and oxygen from which they were formed. Such isotopic waters have differing physical properties and have been effectively used to study the mechanisms of evaporation and solidification of sea waters as well as to tag various water masses.

Members of the uranium and thorium series of naturally occurring radioactive species have been analyzed by the new techniques; the concentrations of their isotopes can also be measured. Instrumental techniques, including neutron activation and isotope dilution, have allowed the analyses of elements in sea water that previously had not been found, such as rhenium and the rare earths. The nuclear era has significantly widened our knowledge of the composition of sea water.

Refinements in the isolation and assay of radioisotopes allowed the time parameter to be introduced to many of the processes taking place in the oceans. The rates of sedimentation, of movements of water masses, and of primary productivity were measured.

However, the nuclear revolution also brought the realization that the activities of man could be recorded in the oceans. Fission and fusion bomb debris and discharges from reactors were building up in sea water and in marine organisms at readily detectable levels.

The concern with manmade nuclear species in the oceans is homocentric. The principle that has guided most national and international policies with regard to the oceanic discharge of radioactivities is that any additional exposure of man to radiation is undesirable. Thus, the lowest practicable levels in relation to social and economic demands for the uses of nuclear energy are sought. Acting upon the advice of scientific groups, national and international agencies have formulated policies such that the radiation doses that people can conceivably receive from the sea are extremely small. This added burden of radiation results primarily from the intake of food products—fish, shellfish, and seaweeds. Thus, a considerable effort has been devoted to studying the interactions of marine organisms with the introduced radioactivities that either go into solution or become absorbed by particles. The large nuclear installations of the British Atomic Energy Authority at Windscale on the Irish Sea and of the U.S. Atomic

Energy Commission at Richland on the Columbia River have put substantial amounts of radioactive isotopes into the oceans. Yet, even in these cases the radiation doses received by those who eat fish and seaweed is far below the recommended limits.

With these radioactivities man has left his imprint in all parts of the world oceans. Up to the present time there is no evidence that these pollutants have had any widespread adverse effects upon marine communities. On the other hand, their very presence has stimulated a great deal of research and has widely increased our knowledge of such phenomena as mixing of ocean waters and the behavior of various chemical species in sea water. For example, these additions of radioactivity provide convenient tags on the movements of waters and sediments. The nuclide chromium-51 has been used to trace the Columbia River waters as they enter the Pacific Ocean to distances of hundreds of kilometers from the coast. Cobalt-60 and zinc-65 have similarly tagged the sediments of rivers. Bomb-produced nuclear species, including strontium-90, cesium-137, carbon-14, and tritium have been used to study the circulation patterns in the atmosphere and the oceans and the mixing rates between and within these two geospheres.

The oceans now have chemical descriptions with the year of analysis. Radioactive species are added to the oceans as a result of man's use of fissionable and fusionable materials. These unstable atoms also decay in the oceans. The compositions of ocean waters now change measurably with time.

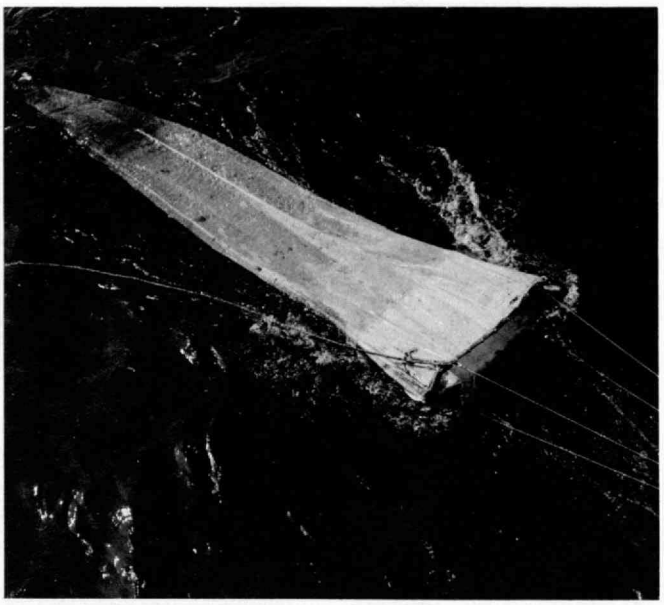
The Oceans and Environmental Management

The despair over the deterioration of our environment as a result of technological advances provides a sense of urgency to gain a deeper insight into what governs the composition of our oceans. The fresh waters, atmosphere, and soils of the world are in various states of degradation as a result of the activities of man. The inadequacies in managing our environment can be gleaned by only a casual perusal of our magazines and newspapers. The real horror programs on television consist of documentaries on our changing surroundings.

The oceans of the world may be the ultimate repository for the metabolic discharges of society. In the United States the problems of controlling the disposition of waste products resulting from the combustion of 7.5 tons of fuel per person per year and from the use of 5.0 tons of mineral, food, and forest products per person per year appear formidable. With the increasing populations and industrialization of the world, man as a collective becomes a potent geological force (the anthrosphere) in altering his environment. Many descriptions of the oceans as a chemical system today are aimed at an understanding of the competitions between man and nature in altering or influencing the composition of sea water as well as of the types of organisms that inhabit the marine domain.

Already the inputs of lead and mercury to the oceans as a result of human activity have equaled or exceeded their inputs by the rivers. The rivers gained their lead burden primarily as a result of natural weathering proc-

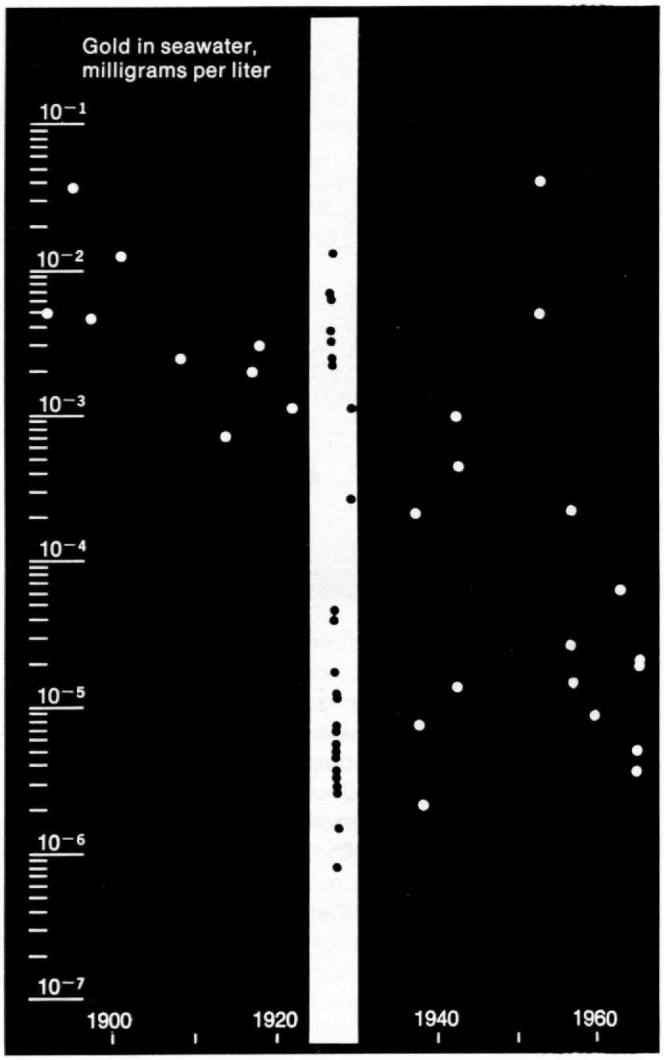
Oil pollution is omnipresent. During a recent Sargasso Sea expedition of R/V Chain of the Woods Hole Oceanographic Institution, "Neuston" nets used to gather surface marine organisms were so encrusted with oil-tar lumps up to 6 cm. in diameter that they had to be cleaned every two to four hours. And in one instance, M. Blumer reports in Oceanus, *on the evening of December 5, 1968, at 25°40' N, 67°30' W, "the nets were so fouled with oil and tar material that towing had to be discontinued. It was estimated that there was three times as much tar-like material as Sargasso weed in the nets," he writes. (Photo: Jan Hahn from* Oceanus*)*



esses. The combustion of tetraethyl lead as an anti-knock agent in automobile engines results in an annual injection of this metal into northern hemispheric waters of at least 250 thousand metric tons per year which compares with river contributions of 150 thousand metric tons per year. This man-induced transfer from the continents to the marine environment takes place through the atmosphere when the lead is removed by rains. It has resulted in raising the average lead content in coastal surface waters of the eastern Pacific from about 0.01 or 0.02 to 0.07 μg./kg. of sea water in the 45 years since the introduction of lead as an anti-knock chemical. The effect of such an increase upon the life in the surface waters is as yet unknown.

The oceans also receive increasingly larger amounts of mercury. Where weathering processes result in the transfer of mercury from the continents to the oceans via the rivers at a rate of 5,000 tons per year, in addition, about half of the world production of mercury, 9,200 tons per year, is released to the environment in an uncontrolled way and most probably ends up in the oceans. The principal source of mercury discharge is the chlorine-caustic soda industry, which requires annually 400 metric tons for replacement of mercury losses. The increase in mercury absorbed annually by the oceans has not as yet been perceived through analyses of sea water. On the other hand, the metal it-

The gold concentrations in sea water are shown as a function of time. The work of Haber in 1928 reduced the generally accepted value by three orders of magnitude. Most subsequent work has been in accord with his results.



self has been involved in several mass poisonings, both of people and domestic animals, as a result of the ingestion of food products from the sea. The Miminata Bay Disease, a mercury poisoning resulting from the eating of fish and shellfish containing toxic levels of the element, claimed 41 human lives in Kyushu, Japan, in the middle of this century. The mercury was discharged into the Bay from an acetaldehyde plant where its compounds were used as catalysts.

Oil and Other Hydrocarbons

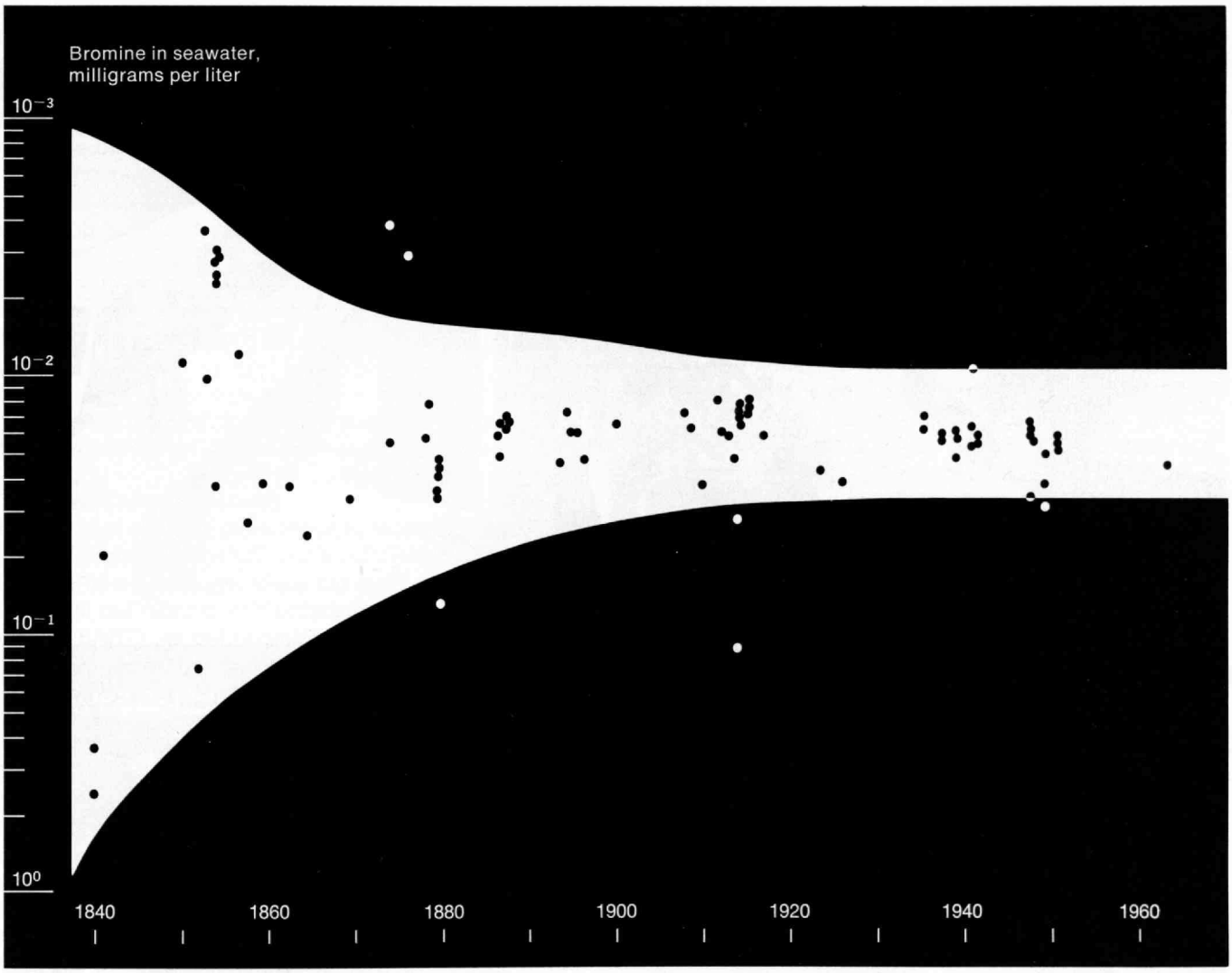
The annual influx of petroleum into the oceans, as a result of losses and spillage in the process of transport, is now estimated to be 1 million tons. This is about 1/10 of 1 per cent of the total load carried by tankers. This continuous injection, which is increasing at about 4 per cent each year due to the increased oil shipments, may be compared to single catastrophic events such as the breakup of the tanker *Torrey Canyon* or the Santa Barbara oil rig leakage, where about 100,000 tons of petroleum were introduced into the oceans in each case.

The response of the oceans to such inputs has already been felt. There are cases of fish tasting of petroleum and reports of whole catches being returned to the sea. Fouled beaches and bird casualties are well known. But it may be that our concerns should relate to the possible long-term effects. Hydrocarbons can pass through and up the marine food chain without alteration and in some cases concentrations can take place at higher trophic levels. The effects such concentrations might have upon the activities of marine organisms are unknown, but clearly are in need of elucidation.

Perhaps an even more insidious invasion of the marine environment has resulted from the widespread utilization of the chlorinated hydrocarbon pesticides about the earth. P,p′ DDT is the chief of these, and its degradation product p,p′ DDE may be the most commonly dispersed synthetic organic contaminant in our environment. These substances have had a profound impact upon marine organisms following their introduction to the oceans by rivers and winds. Already the ultimate survival of a number of species of sea birds has been threatened by their very poor reproductive successes, attributed to accumulations of the pesticide residues in their bodies. These materials upset the calcium metabolism of the birds, which results in eggs with extremely thin shells. These eggs are more liable to breakage and degradation through water loss.

A part of the canned mackerel produced in 1969 was removed from the California market because the fish had twice the amount of pesticides considered safe for human consumption. The levels of DDT residues in the open ocean fish often are of the same order of magnitude as, and sometimes exceed those of their coastal and continental counterparts. This rather unusual and perhaps unexpected situation results from the accumulation of pesticide remains in the rather stable and persistent ocean waters. The consequent exposure of marine organisms to these ever increasing concentra-

The bromine concentrations in sea water are also shown as functions of time. Bromine was discovered in the oceans in the early nineteenth century; its present concentration is generally accepted as about 65 mg. per liter.

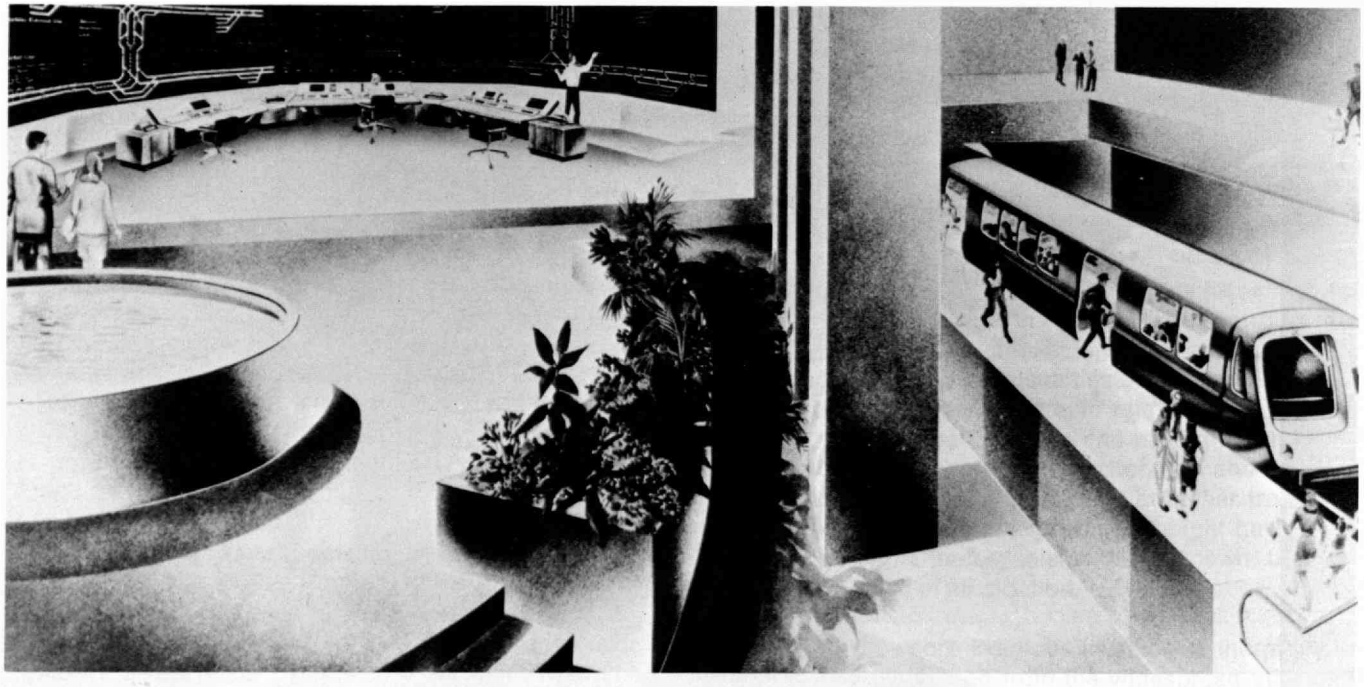


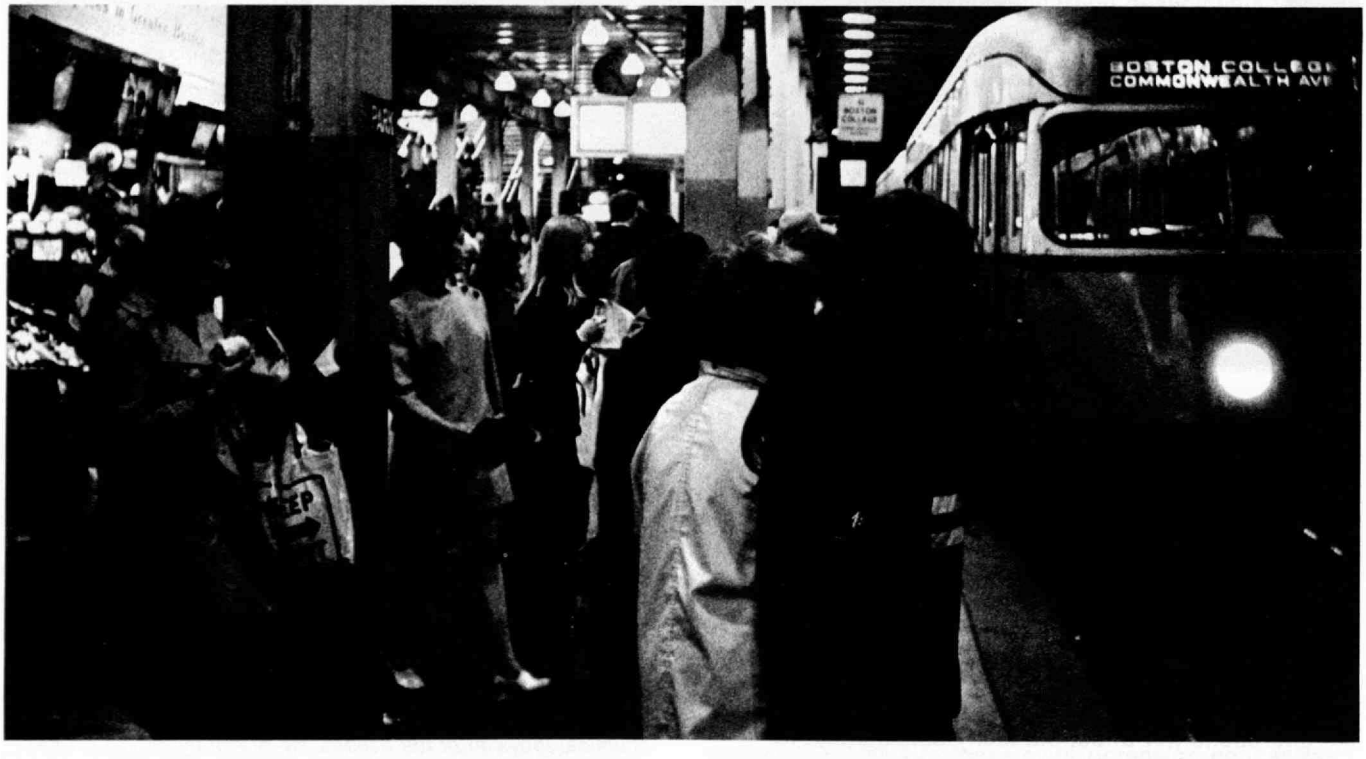
tions of halogenated hydrocarbons has allowed these dramatic build-ups to take place within their bodies. On the other hand, the renewal of inshore and continental waters, which takes place in the matter of a year or years, has kept the burden of pesticides in their fish at levels close to the oceanic ones even though they are closer to the application sites.

The vastness of the oceans tends to blur the realization that their composition is now due in part, a very small part, to the makings of man. In what ways these chemical alterations will affect the many communities of organisms and the physical and geological processes of the seas is yet to be reckoned. The monitoring of this invasion of our surroundings now forms a most significant area of investigations in marine chemistry.

Dr. Goldberg joined the staff of the Scripps Institution of Oceanography 21 years ago, after receiving a B.S. from the University of California at Berkeley and a Ph.D. in chemistry from the University of Chicago. The geochemistry of the oceans and especially the use of radioactive dating techniques to problems of the major sedimentary cycle have been continuing interests; more recently his work is concerned with man's chemical invasion of the oceans. He presently serves on national and international committees which study this problem.

Rapid transit systems currently favored (such as that depicted below) differ from previous subways in their relatively thin coverage of densely populated central areas. Will they attract the patronage that Boston's subway (bottom) has earned? (Artist's impression: Westinghouse; photo: Janet Kreiling)





Will proposed transit systems actually serve those who most need public transit—the poor, the aged, the handicapped—and will people, having a choice, use them?

Martin Wohl
Director of Transportation Studies,
The Urban Institute

Urban Transport We Could Really Use

All too often, improvements to or replications of existing bus, subway, and commuter rail facilities are proposed as means of solving "the urban transportation problem." Usually, the construction of new rail rapid transit systems and the subsidy of existing commuter railroad systems are offered as the most appropriate alternatives for meeting the objectives of:

Reducing highway traffic congestion;
Making public transit attractive, convenient, and competitive with the automobile; and
Affording increased accessibility and adequate public transportation, especially for the poor, aged, and handicapped.

A brief look at these objectives raises serious questions about where current transit proposals would take us.

The New Transit Systems

First, it is of extreme importance to recognize that most current proposals, including the Administration's mass transportation package, focus the great bulk of funds on the usual rail rapid transit proposals (such as San Francisco's BART), on rail facilities linking high-income suburbs or airports with downtown centers (such as Boston's Highland Branch or Cleveland's Hopkins Airport extension), on supplying new cars for suburban commuter railroads (such as the Long Island Railroad), and the like. The so-called subway or rail rapid transit systems currently being proposed or built are more akin to the late nineteenth and early twentieth-century suburban commuter railroads than to inner city subway systems of the same period. Generally, the lines for these new rail rapid transit plans range far into the suburbs and concentrate most of the stations within the suburbs. Stations are spread far apart and thus provide poor linkages between the station and one's origin or destination. They virtually require travelers to use another mode (such as feeder bus or private auto) for the trip between the station and one's origin or destination.

To illustrate this, several statistics comparing new rail transit with full-fledged city subways are useful. First, the average station spacing for most, if not all of the proposed rail transit systems will exceed 1 mile—about 1 1/3 miles for the Los Angeles plan, almost 1 1/5 miles for Washington's METRO, almost 2 miles for San Francisco's BART. Yet spacing for Chicago's existing rapid transit system is only 2/3 of a mile, that for the existing systems in Boston and New York only about 1/2 mile.

Second, the newly built or proposed lines are long. Those for BART will *all* exceed 20 miles in length. Those for METRO will average about 12 miles, but some will approach 20 miles. By contrast, Boston's longest rapid transit line is less than 15 miles long. None of Chicago's lines are longer than 16 miles, none of Philadelphia's more than 20 miles, and only rarely do New York City's exceed 15 miles.

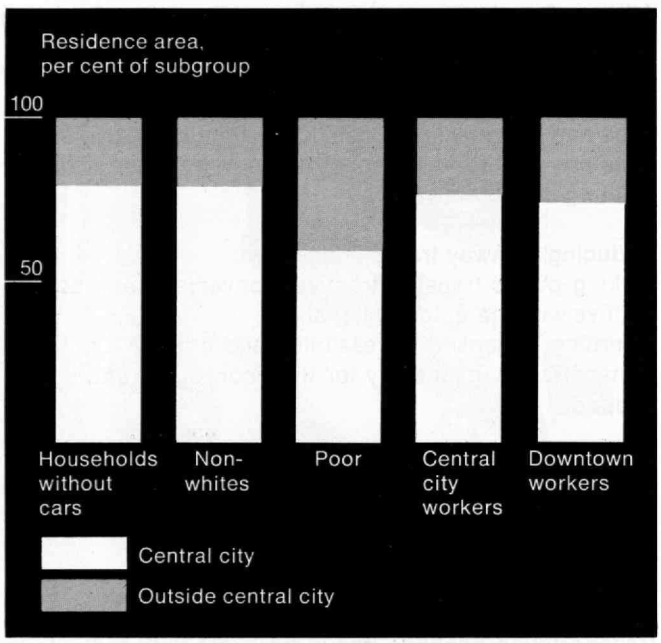
A third statistic concerns cities and suburbs. The 75-mile BART system, when completed, will have only 8 of its 75 miles within the City of San Francisco. Yet the city itself has the highest residential density of the area served and houses about 72 per cent of San Francisco workers (and thus potential riders). Only 11 of the 37 BART stations will be located within the City of San Francisco—the others will be spread widely throughout the suburbs—and only 7 stations will serve San Francisco residential areas outside the business and commercial core. By contrast, in Boston, a city of approximately the same geographical area and population density, the 40-mile rapid transit system is heavily concentrated within the central city, has 1/2-mile spacing, and has almost 50 stations located within Boston itself, with less than 25 in outer areas. Only 8 of the outlying stations are more than one mile from the central city. To show the pattern another way, the Boston system concentrates 23 stations within its small 1.4-square-mile downtown area, while the Washington METRO system will focus only 14 stations within 2.2 square miles and San Francisco's BART will have only 5 stations in 0.9 square miles.

In short, neither the line mileage nor the station coverage of the new or proposed rapid transit systems—unlike previously built subways—will be concentrated within the central city or urban core areas but will be focused more prominently on the suburbs, a role traditionally followed by suburban commuter railroads.

This extended pattern for the new type of rapid transit comes about in part because engineers and designers have decided to stress a high average enroute speed. Given that overall speeds include station dwell-time, the high speed requirement makes it necessary to spread stations far apart and to extend lines far from the core.

Where are transit facilities and stations located in relation to workers or others having the greatest potential need for using these facilities?

Within a typical metropolitan area, 80 per cent of the households without cars, and therefore likely to need public transport, reside in the central city. The same holds, in different degrees, for other factors relevant to the need for transit systems.



Those Who Need and Will Use Transit

Of the metropolitan area workers who are members of households owning no automobile, over 80 per cent reside within central cities and less than 20 per cent reside in the suburbs. The preponderance of urban poor also live in the central cities: in 1964, about 60 per cent of the metropolitan areas' poor and about 80 per cent of their nonwhites.

Along these lines, note that ¾ of the San Francisco Standard Metropolitan Statistical Area (S.M.S.A.) occupied housing units which have no automobile available are located within the City of San Francisco—precisely that portion of the San Francisco region which will least be served by BART in terms of mileage and numbers of stations. New York City is the extreme case: about 94 per cent of the New York S.M.S.A.-occupied housing units with no automobile are located within the central city.

Also pertinent is information about the young and the old, both of whom presently use transit less than other age groups. While there is now a greater population in the suburbs than in the central cities of S.M.S.A.'s, a greater proportion (about 55 per cent) of the aged—those 65 and older—still reside within central cities. With youth, the situation is reversed: about 57 per cent of the very young—those less than 14—live outside the central city.

Next, a look at downtown workers, the great bulk of whom tend to live within the central city rather than in the suburbs. In Chicago, a city served by a 70-mile rail transit network and an over-400-mile commuter railroad network, about 60 per cent of the central business district workers live within 8 miles of the C.B.D., and about 74 per cent within 10 miles—the average distance between downtown Chicago and the city limits. We can estimate that only one-fourth of Chicago's downtown workers commute from the suburbs. In Detroit, a city of much less density and having virtually no rail service, the corresponding percentages are 70 and 94 per cent—and Detroit's city limits are roughly 8 miles from its C.B.D. Only 19 per cent of the mid-Manhattan (or C.B.D.) workers live outside New York City, and the great bulk of those fall within high-income groups. New York has about 1,000 miles of commuter railroad to serve its out-of-city commuters. In Washington, D.C., only 20 per cent of the downtown workers live more than 6 miles from downtown and only 5 per cent live more than 8 miles from downtown; the 6 mile distance is equivalent to that between downtown and the city limits.

These observations can be strengthened by data on the percentage of central city workers (not limited to central business district or downtown) who also live within the central city. For all S.M.S.A.'s having a 1960 population of 1 million or more, about 75 per cent of the central city workers lived within the central city. The percentages for aggregated S.M.S.A.'s of smaller size did not vary considerably from that figure. For cities within the 1-million-or-higher class, the percentages varied markedly—i.e., in New York, some 90 per cent of the central city workers also lived within the central city; for Chicago, Philadelphia and San Francisco the percentages ranged from 79 down to 71; in Boston and Washington, D.C. they were 53 and 56; in Cleveland, 62 per cent. These data emphasize that the problem of getting to work can hardly be characterized as a suburban commuter problem.

We have been looking at where the people live who need urban transportation. Equally important in terms of work-trip commuting is where these people work—the *job distribution* throughout the urban area. The largest single concentration of urban jobs is clearly in the

downtown or central business district. But one should not be led to believe that this center accounts for virtually all or even a majority of the urban work-trip commuting. Five- to ten-year-old data on the percentage of urban-area jobs located within the C.B.D. shows the following for some of our largest and densest cities now or soon to be served by rapid transit systems: New York and Philadelphia have the largest number of their urban jobs located downtown—28 and 29 per cent respectively; San Francisco has 17 per cent, Chicago has 14 per cent, and Washington, D.C., has 24 per cent. In all of these cases, the percentages are rapidly declining and in some of them the absolute employment level downtown is falling as well.

In sum, most urban workers are not employed in the downtown core. And those people who do work downtown generally reside within the limits of the central city (not in the suburbs) and reasonably close to downtown. Finally, the great bulk of urban jobs are located outside the central business district—and thus workers on these jobs are not well served, if served at all, by downtown or radial-type fixed rail systems. Clearly, a "solution" of the downtown commuter problem is not addressed adequately to the whole urban transportation problem.

Income Levels of Transit Users

Available data with respect to the incomes of public transportation users are far from sufficient to make any but highly tentative statements. However, users of subway or existing short-distance rail rapid transit facilities generally tend to have higher incomes than do bus users, and travelers using longline rapid transit or commuter railroad facilities (as a group) are considerably wealthier than other urban dwellers and transit users. The following examples illustrate this point.

Data gathered in the early 1960's on Boston's Highland Branch extension (the longest line on Boston's rapid transit system) and on the Boston and Maine railroad commuter lines show that their riders come from families having almost identical household income levels and that the median family income of the commuters' households is about $9,400. This figure is almost 40 per cent higher than the $6,700 median family income of Boston S.M.S.A. residents.

More recent data were gathered for riders of the widely publicized Skokie Swift facility in Chicago, a commuter shuttle which terminates about 14 miles from the Loop and links the Village of Skokie to the C.T.A. rapid transit system. Riders of this facility come from families having a median family income of about $13,000—a level almost 75 per cent higher than the $7,400 median family income for Chicago S.M.S.A. residents.

What about railroad commuters in the New York region? First, the extensive 1,000-mile New York commuter railroad network is used almost exclusively by downtown workers living outside the five-borough New York City; less than 1 per cent of the mid-Manhattan workers living within New York City use commuter railroads at least once in their journey to work as compared to 50 per cent for those living east of New York City and 68 per cent for those living north of New York city. Second, about 53 per cent of the downtown workers who live in the suburbs, but only 23 per cent of those who live in the city, hold executive, professional, or administrative jobs. Third, and focusing more closely on the residents of the suburbs making widest use of the commuter railroads, 63 per cent of those commuters living north of New York City (principally within Westchester and Fairfield Counties) and 54 per cent of those east of New York City (primarily within Suffolk but secondarily within Nassau Counties) hold executive, professional, or administrative jobs—in contrast to 23 per cent for New York City residents. Even more indicative of the disproportionately high income levels for suburban commuters are similar data on the percentages of workers holding executive jobs; for the three residence areas just cited, the percentages are 22, 18, and 5 per cent respectively.

These data, coupled with that in the previous section, lead me to conclude that the improvement of public transportation facilities for long-distance downtown commuters who live in the suburbs will principally serve the interests of a well-to-do and small segment of the urban populace.

Impact of These Commuter Systems

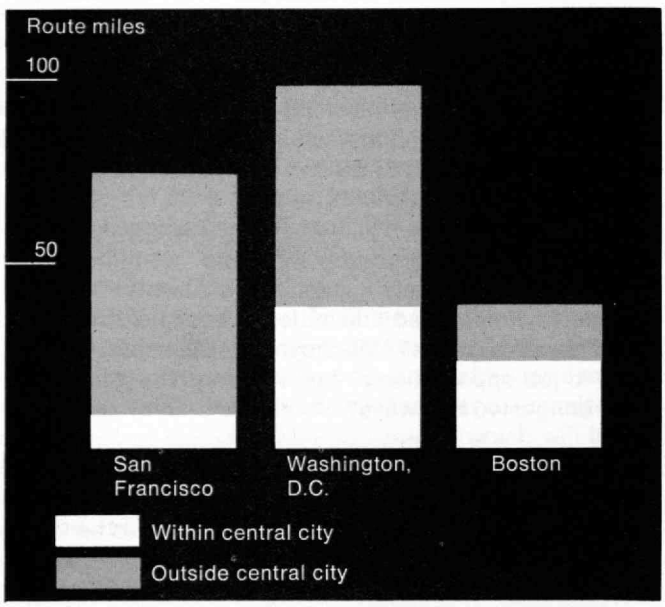
What, then, is the likely impact of the current transit proposals of improved commuter railroads and rail rapid transit systems? Will they open up or provide access to job opportunities? And will they divert traffic from congested highways?

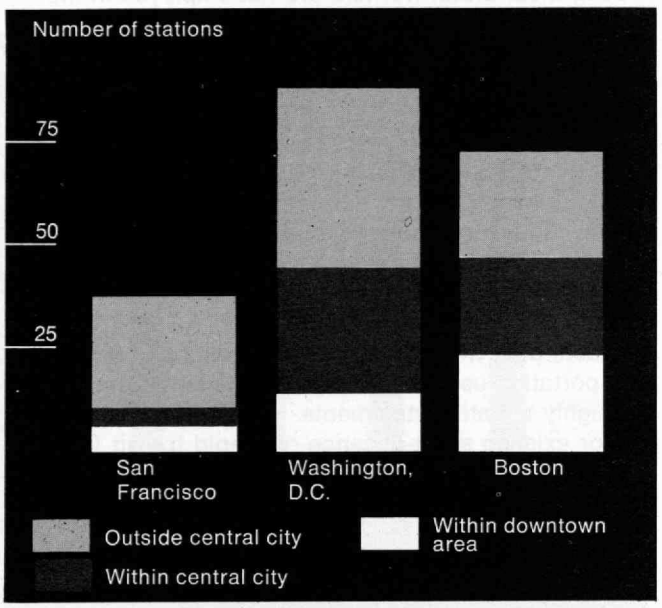
Of those who will be served by the new transit lines few will be likely to forsake their automobiles: given the nature and level of the door-to-door service to be afforded by proposed systems, large or even heavy shifts from auto to transit travel cannot be anticipated.

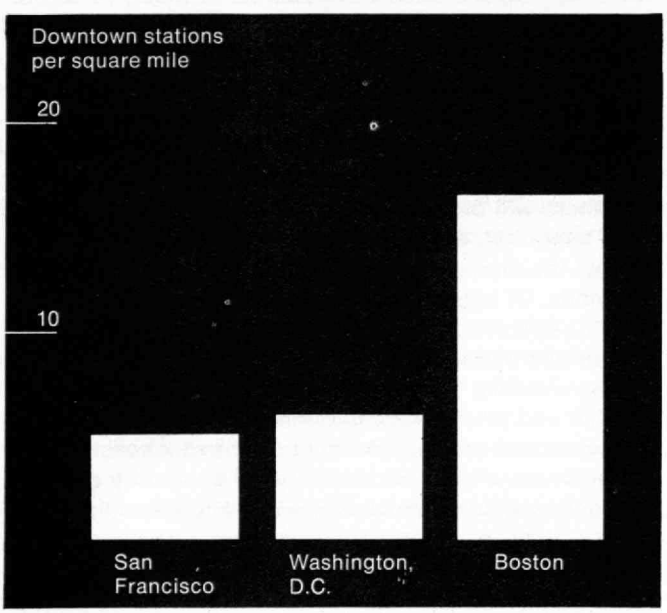
Most commentators and writers tend to depict the traveler's problem as one of deciding between two simple, dichotomous modal choices—that is, between transit and the auto. The problem, however, is hardly so simple or clearcut. Even today a wide range of modal choices, rather than two simple ones, is available, and there will probably be an even wider set available tomorrow, as populations and incomes magnify and as the market responds to new and changing demands. Of equal if not greater importance is the fact that the transit mode is generally restricted to only one or two classes of service. Thus, different people having different tastes usually have but two transit service and price levels to choose from: either bus transit or taxi service. (An important exception to this situation sometimes occurs in areas served by commuter railroads, such as Nassau and Suffolk communities in New York State, having two or more classes of rail service, the best class of which, the parlor car, affords a reserved seat, considerable comfort, privacy, and the luxury of a steward and bar service at one's seat.)

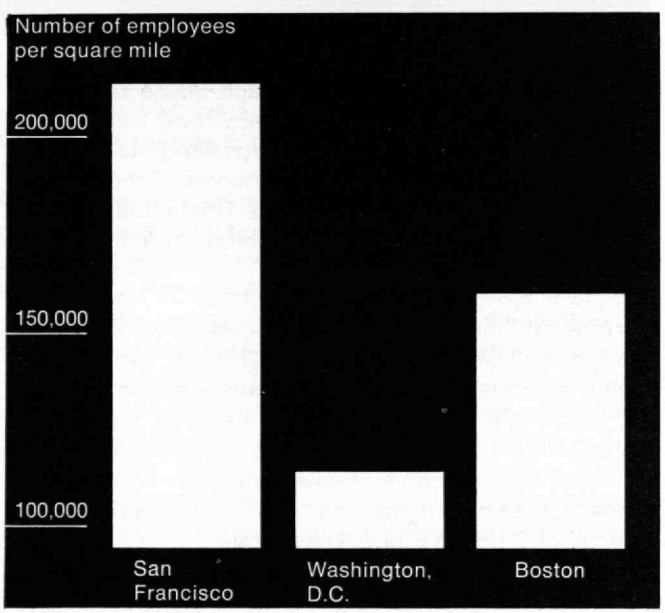
By contrast, for private auto travel, the choices range from chauffeur-driven service, to driving alone (with or without owning the vehicle), to a two-person car pool, to a six-person car pool—a set of perhaps seven price and service classes. Also, the range of choices with respect to scheduling, routes, and destinations are

Comparison between the Boston subway and two future metropolitan transit systems: in terms of the number of route miles within and outside the central city; of the number of stations within the central city and the downtown area, and outside the central city; and in terms of the density of stations in downtown areas—which relate in no obvious fashion to the downtown density of employees.









virtually unlimited for either the chauffeur-driven or drive-alone cases; for car pooling, however, the choices in space and time are restricted even more than for transit.

Choices Are Not "Irrational"

These points should be kept in mind as one attempts to clarify the urban transport scene. They will help in assessing our almost single-minded concern with: (1) the lowest cost urban transport mode; and (2) providing high speed on the grade-separated or line-haul portion of the rapid transit system.

As implied, it is popular to decry the "irrationality" of urban travelers in choosing other than the cheapest available mode, despite service differences. And we have a penchant for comparing the costs or "efficiency" of different modal systems while disregarding their service differences. The traveling public, however—in deciding whether to buy and use autos, whether to join a car pool, or whether to use available transit service—is not *just* interested in choosing the lowest cost; otherwise, it almost surely would form six-person car pools while using used compact cars with standard transmission and no extra frills. Nor should government agencies, planners, designers, and analysts searching for the "best" system simply compare the alternative modes on the basis of lowest cost to move some specified number of people, regardless of their absolute and relative service characteristics. The problem is little different from that of making a choice between a cafeteria and a restaurant. In fact, the only times when simple, straightforward cost comparisons between choices are valid are when there are no service differentials or when the service differential is of no consequence to the public.

The Job Problem

Considerable pessimism must also be expressed about the likelihood of opening up or providing access to job opportunities, particularly suburban ones. Recall, first, that for most of the major systems being proposed, the transit lines will be fixed-rail, radial in nature, and centered in the downtown area. Second, realize that inner-city residents—particularly blacks and other urban poor—tend to reside in rings just outside the periphery of the downtown and central city core area.

To enable ghetto and core area residents to take advantage of suburban job opportunities, these rail transit facilities usually require an in- and an out-trip to make the one-way journey to work. That is, to go to work, city residents would have to use one line inbound to get to a downtown rail transfer point and then take another line for the radial journey out to a suburban job location. Furthermore, the suburban job site would have to be located either within walking distance of the suburban stop or to have a good feeder bus service. The latter would most often be the case, in view of the characteristic one-story, horizontal production and operating facilities of suburban plants—a structure which forces firms to spread out rather than to group in high-density patterns adjacent to transit stations.

Conclusions and Possible Alternatives

Most proposed transit programs are focused primarily on improving public transportation for long-distance downtown commuters. The bulk of funding is focused on extended rail transit to the suburbs, where downtown workers most likely to need better facilities do not live, and is not generally focused on serving the poor, aged, or handicapped. The anticipated service will probably be little different or better than that which has been available to the well-to-do suburban commuter for many decades.

On the contrary, those types of public transport facilities which do offer considerable potential for serving either masses of riders or the poor, old, and handicapped, and those transport systems which do stand a chance of competing with the automobile (in terms of service and cost to the user) receive far too little attention. To take two examples: first, work on newer, flexible and/or high-service types of technologies or operations (such as "dial-a-bus" or dual-mode) seems to receive scant effort, rather than the support consistent with their potential. The mass transportation proposals of the Administration have budgeted only $500 million for research and development, which would include systems such as these, and the rest of the $10 billion for equipment and systems similar to existing ones. Second, the public taxi: this concept is regarded by some as "the transit system of the future" because of its higher service features (which are increasingly desired by a society of growing affluence), and because of its immediate high potential both for large masses and for the poor, aged, and handicapped. It seems to be excluded from the class of public transportation services

San Francisco (below) and Washington (right) transit systems (future) and Boston system (far right) (present), all drawn to the same scale. The grey area in each case is the central city, of which the population and area are shown in the table; the table also gives the downtown-area figures used in arriving at the bar-chart comparisons on pages 32 and 34.

City of San Francisco

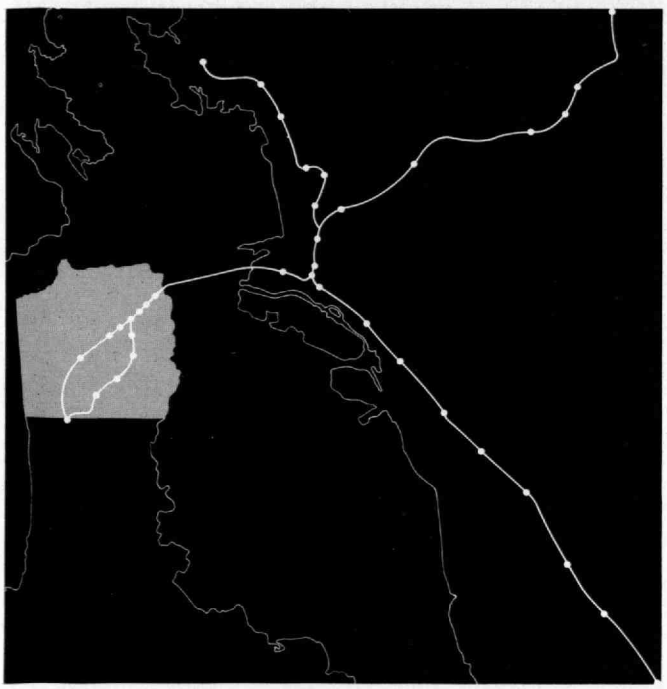
Population:	740,000
Area:	45 sq. mi.
Downtown area:	1.3 sq. mi.

City of Washington, D.C.

Population:	764,000
Area:	61 sq. mi.
Downtown area:	2.22 sq. mi.

City of Boston

Population:	697,000
Area:	48 sq. mi.
Downtown Area:	1.37 sq. mi.

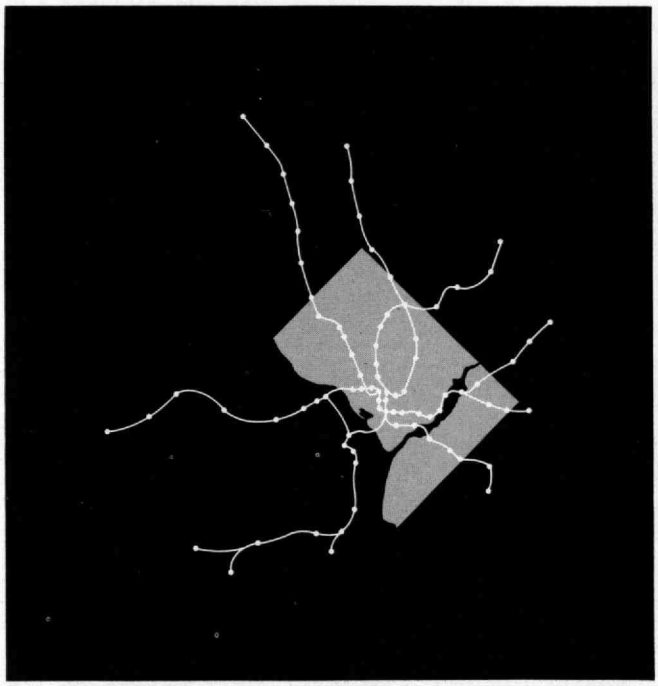


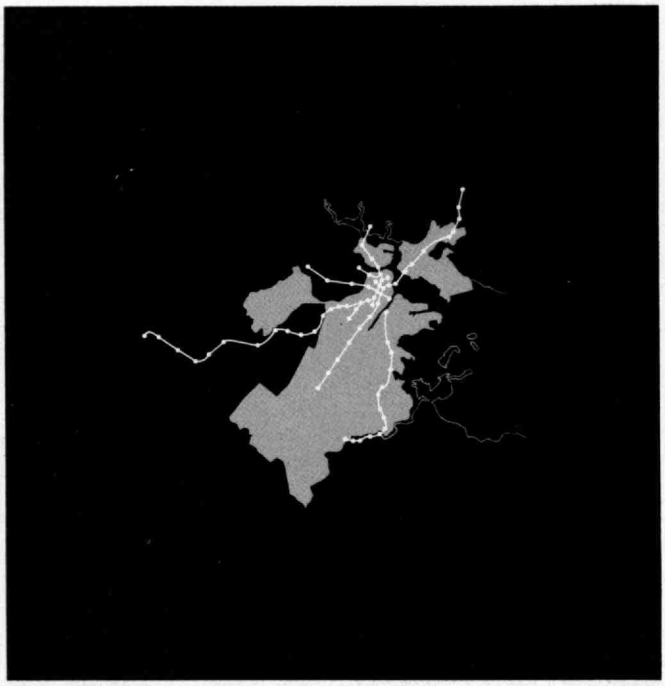
generally considered eligible for government study and funding.

The omission of taxis from consideration within overall public transportation programs should be seen in the light of the following statistics. In the New York City region, almost 1 million person-trips are made daily in taxicabs (about 85 per cent are made in all of New York City, about 50 per cent in Manhattan alone). This compares with about 400,000 daily passenger trips on commuter railroads and about 4.5 million trips on rail transit (subway). These figures alone should give pause about investing in commuter railroads rather than taxis. The argument for attention to taxis is strengthened when it is recognized that this high taxi usage results even with inefficient utilization of cabs, present fare levels, and high monopoly rent. Moreover, the difficulties of the aged and handicapped—climbing stairs, getting in and out of doors, managing in quick starting and stopping vehicles, and so forth—suggest that taxi service is more suitable for them than bus or rail service. Also the freedom of origin, destination and route choices that taxis have, compared to other transit services, is too obvious to dwell on.

What then are better prospects? As time wears on, the traveling public will demand increasingly better service —better comfort, freedom from the driving burden, higher speeds, fewer stops, and so forth. If these judgments are valid, what services and technologies seem most appealing? In the near term, I would argue that the possibilities of high potential are all too obvious:

1. The private automobile, much as we now know it, will continue to dominate; increasingly, though, attention will turn to the second-car market—one which is steadily climbing and which already includes almost 30 per cent of the U.S. households;
2. Extension of taxi services. Among the most urgent changes to be considered, if not adopted, are the establishment of free entry for taxis, the use of differential peak and off-peak rates, and use of computer routing;
3. Dial-a-bus, which essentially can be regarded as a large-vehicle taxi service in which some degree of pooling takes place and in which efficient routing is accomplished by making use of computer-aided routing systems; and
4. Express buses, whether operated over existing highway facilities, over reserved express bus lanes on expressways or streets, or over special grade-separated





rights-of-way (perhaps by paving over abandoned or underutilized railroad right-of-way).

Over the long term, more glamorous possibilities seem possible if not probable. Included would be automated highways, dual-mode vehicle systems, and other such systems which would take advantage of the inherent technical advantages of grade-separated, controlled-guidance rail technology and of the high service features of personal, private automobiles. Clearly, though, the most difficult aspect of implementing a workable and sufficiently large-scale (and thus viable) automated highway or dual-mode system (assuming we can validate its worthwhileness) would center on the institutional setting—on integrating the fragmented private, public and quasi-public industries and agencies which now own, operate or control different parts and aspects of the overall system; and on financing and pricing such technologies.

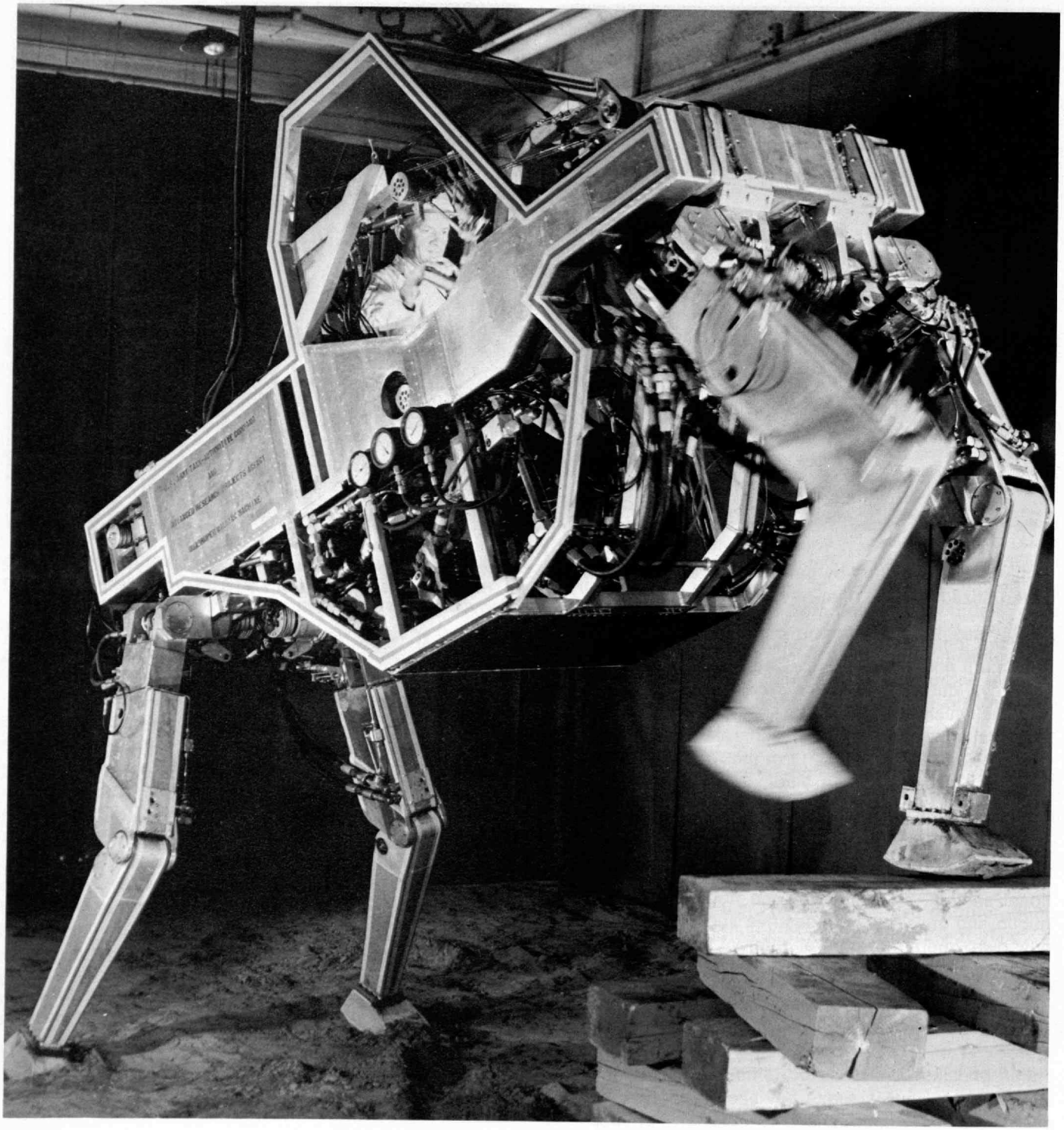
Suggested Reading

J. R. Meyer, et al., *The Urban Transportation Problem,* Harvard University Press, 1965.

Martin Wohl, "Users of Urban Transportation Services and Their Income Circumstances," *Traffic Quarterly,* January, 1970.

Martin Wohl recently joined the Urban Institute as Director of Transportation Studies. He has served as manager of the Transportation Analysis Department at Ford Motor Co., as a senior staff member at The RAND Corp., and as a consultant in various capacities. He holds both his S.B. and S.M. from M.I.T. and his D. Eng. from the University of California (Berkeley). He has served on the faculty at both schools and also at Harvard.

"Research prototype of a four-legged quadruped [sic] machine, fabricated by General Electric Company engineers under a U.S. Army contract, was designed to spur development of equipment that will improve the mobility and materials-handling capabilities of the foot-soldier under the most severe conditions." (G.E. press release)



Just as there is an activity known as pure science, there is also pure technology. From its beginnings in the ancient world, it has continued to this day, important but seldom recognized

Pure Technology

In a characteristic passage in Plato's *Republic* we find Glaucon and Socrates discussing the nature of the Good. Glaucon suggests that there are three kinds of good: the simple, inconsequential pleasures; then activities pleasurable both in themselves and their consequences; and finally those tasks and duties not inherently pleasant but undertaken for subsequent advantage. He then asks Socrates to locate "honesty" in one of these categories.

Socrates: I should say, in the best of the three, those which a man must like both for their own sake and for their consequences, if he's going to live the kind of life one wants to have.

Glaucon: Well, that's not what most people think; they reckon it belongs to the tedious kind of good, which has to be pursued in order to earn a wage, or, for appearance's sake, to be well thought of.

Glaucon's threefold subdivision remains relevant to this day, and the passage would retain its point if the philosophers had been discussing technology. The usual attitude taken towards technology—certainly by those who put up the money for it—is that its value lies only in its profitable consequences, and research and development in itself is an unavoidable interim expense. Yet to the engineer the chase may be as rewarding as the kill; he may well privately place his activities in the second or even in the first category of good, divorcing it partly or almost wholly from the sordid aftermath of profitable application.

This attitude of mind defines the *Pure Technologist.* Pure technology is the building of machines for their own sake and for the pride or pleasure of accomplishment. It is a creative art form somewhere between art and science. Some examples of pure technology are the record-breaking vehicle, built purely to see if it will behave as intended; the chess-playing computer program, devised for the sheer entertainment of seeing how well it makes out; and that masterpiece in miniature, *Scientific American*'s Great International Paper Airplane Competition.

Most other technical projects have some degree of purity, though the assessment of such a subjective quality will rarely be clear-cut. What is the purity status of a cuckoo in a cuckoo clock, for example? Or on a grander scale, is a particle accelerator pure technology? To the physicist it is as applied as any other of his instruments; to the engineer constructing it, it has only to work as intended, and so is pure; an outsider will judge it as pure or as applied according as he judges nuclear physics itself. Yet despite its confusion with (and indeed, latterly, deliberate disguise as) the applied variety, pure technology is recognizable throughout history as one of the minor muses.

Classical Pioneers

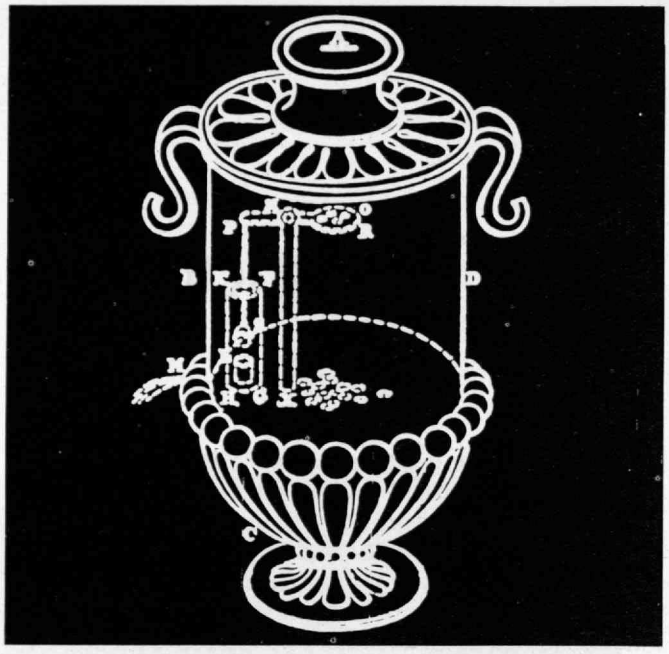
The first indubitable instances occur rather late in Classical times. The great Athenian achievements in art and science occurred without any comparable revolution in technology. Nowhere do Glaucon or Socrates express any appreciation of the aesthetically or intellectually stimulating qualities of technology—for them it was firmly in the third, humdrum class of good. Not until Alexandria took over from Athens as the intellectual center of the world did major progress in empirical techniques occur. The "Museum" at Alexandria, founded around 300 B.C. by one of Alexander the Great's generals to be the intellectual showpiece of his regime, was for many centuries a unique library, artistic center, and research institute, and shared so many of the features of modern research establishments that it may fairly be called the M.I.T. of the ancient world.

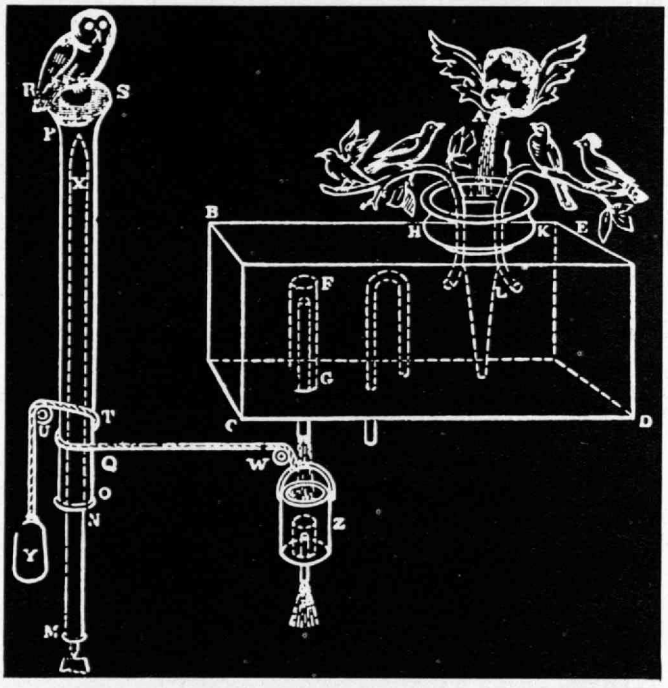
The Alexandrian pure technologists were the mechanicians, chiefly Ctesibius, Philo, and Hero. That part of their research which directly served the interests of their employers was, as one might expect, military—improving the catapults and ballistas which launched the missiles of the time. But they also carried out much more fundamental and far-reaching research in pure physics.

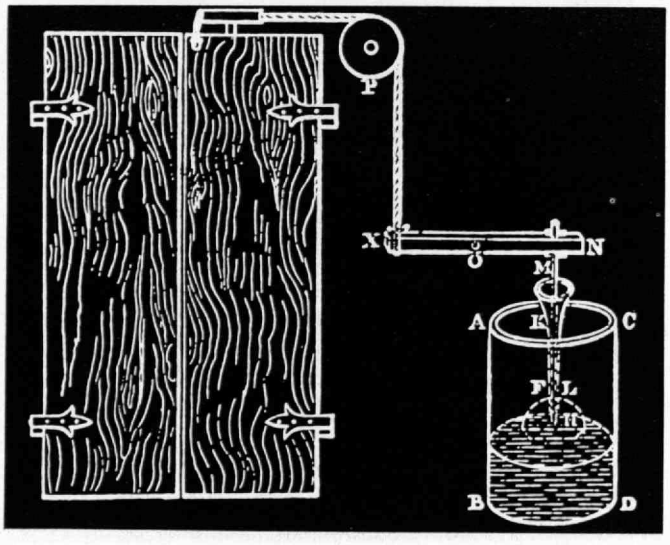
We know little of Ctesibius except from contemporary references. The Roman engineer Vitruvius tells us that he invented the force-pump, a hydraulic organ, two different forms of catapult, the water-clock, and several types of automata. The stern, practical Roman describes only the pump, the organ, and the clock, and refers us to Ctesibius's own book (now lost) for details of other devices "which serve no useful purpose, but the pleasure of delight."

These delightful inventions are described in one of the

(Top) the first coin-operated vending machine. The vessel dispenses holy water when a coin (five drachmas) is dropped through the slot on to the lever.
(Center) ". . . such a form as Grecian goldsmiths make
Of hammered gold and gold enamelling
To keep a drowsy Emperor awake;
Or set upon a golden bough to sing
To lords and ladies of Byzantium
Of what is past, or passing, or to come."
It has been suggested that the progenitor of Yeats' image is this hydro-pneumatic system by Hero of Alexandria. When the main vessel is being filled with water, the expelled air "will produce the notes of birds"; as the water drains out, the owl turns toward the tree and the birds are silent.
(Bottom) Automation in ecclesiastical ritual. When the temple doors are opened, an inverted vessel is lowered into the water, and air escapes from it through the trumpet.







surviving treatises of his follower, the famous Hero of Alexandria. Hero probably lived about 100 B.C. and wrote treatises on catapults and missiles, on automata, and on the studies in pneumatics for which he is best known. His books give the first description in recorded history of the works of men who, fascinated by a new science, set out to see what could be done with it for the sheer pleasure of creation. Pure technology was on the march!

Some of the *jeux d'esprit* of the Alexandrian mechanicians are shown in the diagrams. All five "classical machines" (lever, wedge, screw, pulley, and winch) are used in these little contrivances, as well as the float, syphon, water-whistle and other elements discovered or at least first understood at Alexandria. The elasticity of air and the incompressibility of water are recognized and ingeniously exploited; and despite the dry and Euclidean way Hero expounds their working, it is clear what fun he had putting them together.

Some commentators have ridiculed them as "mere scientific toys," but I think this misses the point. Toys they were indeed for the most part, but they were toys embodying new and important principles which the mechanicians used in more practical equipment, and attempted to explain by theory. Hero never quite explicitly expounds the concept of atmospheric pressure, but he is quite sure that air is a material substance, and gives directions for constructing apparatus to prove the existence of a vacuum. For 100 B.C. this is physics of a high order indeed!

The most famous of all Hero's "toys" is his steam reaction-turbine or Aeolipile, number 50 of the 78 inventions in his *Pneumatics.* This simple machine merely drove itself and illustrated a principle, and there is no reason to suppose that Hero ever envisaged scaling it up. Nowhere in the ancient world was there a more propitious place to make such a revolutionary invention than the Museum at Alexandria; yet nothing came of it. The technical and intellectual and social infrastructure was far too inadequate to handle the application of this piece of pure technology, and the Alexandrian achievement petered out with the general decline of the ancient world in the first few centuries A.D.

The technoscientific reactor did not go critical for over another thousand years, until the European Renais-

sance. The first really striking piece of pure technology to emerge from the intellectual ferment that followed was the balloon.

The Balloon Goes Up

The brothers Montgolfier were papermakers of Annonay in France, and were of an inventive and curious turn of mind. Etienne Montgolfier once tested Leonardo's concept of the parachute by jumping from the top of a building holding a large umbrella! The concept of lighter-than-air flight seems to have matured in their minds from 1767 onwards. They knew of Cavendish's preparation of hydrogen, but a small pilot balloon lost the gas so rapidly by diffusion through the (paper) envelope that they abandoned this notion.

The idea of the fire-balloon is said to have occurred to Etienne on a carriage ride. Immediately on reaching the inn of his destination he called for taffeta and fire, and, to the horror of the proprietor, the world's first lighter-than-air flying machine, made of badly singed taffeta, rose nobly to the ceiling of one of his bedrooms!

The Montgolfiers organized their first demonstration flight from Annonay market square on June 5, 1783. The craft was made of paper (the material they were most familiar with) and reached a height of 6,000 feet. Garbled reports by the mystified local authorities reached Paris, where Professor Cesar Charles (of Charles' Law fame) deduced that the Montgolfiers must have been using hydrogen. Determined to emulate their feat, he set about the frightening task of filling a 1,000-cubic-foot rubberized silk balloon with hydrogen generated from iron and sulphuric acid.

Four days it took, during which time the Professor and his assistants were in constant fear of an explosion: at times the exothermic reaction became so violent that the whole assembly had to have water played over it. But all went well, and the first hydrogen balloon ascended triumphantly from Paris on August 26, 1783, travelled 15 miles, and was destroyed on landing by horrified peasants. Only when the Montgolfiers exhibited their invention in Paris did Charles realise that he had invented the hydrogen balloon by mistake.

Ballooning soon became a popular activity throughout the Continent. Brave men ascended in both hot-air and hydrogen balloons (Charles reached 10,000 feet on December 1, 1783, and returned safely). The new invention was soon subsidized by the military, who dreamt of balloon transport and aerial observation flights. Indeed, a ballooning corps was formed in the French army after the Revolution; but this near-farcical concept was never a serious threat. The House of Lords dissolved in laughter when Lord St. Vincent, in 1813, speaking of the defence of Britain against Napoleonic invasion, remarked "I do not say they cannot come. I only say they cannot come by sea." Again, a novel extension of human abilities had been developed and exercised for its own sake, and funded by authority on grounds that would not stand up to hostile cost-effectiveness analysis.

Modern Pure Technology

The massive flowering of invention of the modern era poses for the connoisseur of pure technology the challenge of identifying unambiguous examples of the genre. This is surprisingly difficult. On the face of it, practically every invention made since about 1800 was immediately applied.

But this may not mean that pure technology ceased to exist—only that it was rapidly overtaken by applications. Many of Hero's inventions were never applied at all—the concept of research-based technology scarcely existed in his society. Leonardo da Vinci's beautiful mechanical concepts took centuries to reach fruition (I cannot claim him as a pure technologist because he was essentially a theoretician rather than a practical inventor); Montgolfier's remained pure long enough to recognize as such. But the genius of a technological age lies not in scientific advance or creative imagination, but in seeking applications, in consciously and persistently asking the question, "How can I exploit this?"

Just how automatic and comprehensive this technique of progress has become, with each new piece being fitted into the growing jigsaw puzzle as soon as the development of neighboring fields permits, may be judged by trying to think of inventions in the mainstream of technology which might have been made much before they actually were. (After some cogitation, I can list only seven: gas-phase chromatography, the hovercraft, the standardized goods-container, prestressed concrete, the disc brake, casein glue, and DDT-based insecticides. Perhaps readers can add to—or substract from—the list?) The great majority of inventions appear just as soon as they become feasible.

The clue to discovering pure technology—things made for the sake of making them—in this relentless advance, is to identify developments which, although they occupy obvious and clearly fillable gaps in the jigsaw, are simply unnecessary: gaps which are not worth filling on any rational basis. This test works best on fairly new inventions, before the patina of age and seeming inevitability has settled on them.

A prime example is the S.S.T., an indubitable masterpiece of thinly disguised pure technology. I need not detail here the ample demonstrations which have been given of the pointlessness and social drawbacks of this project. But given a journey of, say, seven hours at an average of 10 mi./h and another six at 600 mi./h (a fair profile of a typical transatlantic air excursion), the expenditure of millions of dollars to clip a few hours off the *high-speed* section seems misguided to say the least, even assuming it is worth shortening the time at all in view of the increased disruption of circadian rhythms. Balancing this insignificant gain and the tiny minority who gain it against the solid debit in expense and noise pollution inflicted on the majority, we can see how unexpectedly powerful is the drive to pure technology in our supposedly cost-conscious society—for the only really compelling reason for building the S.S.T. (and of course its rival the Concorde) is the sheer entertainment of overcoming all the technical problems and finally flying such a thrilling machine!

More Examples

The same motivation applies in a practically overt manner to the space-rocket. The big rocket is the twentieth-century pure-technological achievement *par excellence,* but all its pioneers—Oberth, Goddard, von Braun—saw it not as an end in itself but as a means toward the larger pure-technological goal of space-flight. Even when the first successful V-2 ballistic rocket was fired in 1942, officially part of German war research, von Braun exclaimed jubilantly that the only trouble was that it landed on the wrong planet! Again, no scientific or technical considerations can justify on economic grounds the billions of dollars invested in the space program. Even the solid military interest in rocketry and radar and long-distance communication would have been far better served at a fraction of the cost by normal research and development. Yet the splendor of setting foot on our satellite, the sheer poetry of sending our creations out to scan other worlds and report back what they see—these represent pure technology at its best. It seems almost carping and small-souled to query whether the money might not have been better spent on more urgent terrestrial matters.

A quite different instance of modern pure technology, this time not quite rapidly enough overtaken by events to obscure its real appeal, is the laser. The appearance of the first practical prototype in 1960 created such interest that, in the words of the *New York Times,* "almost every corporation and every self-respecting university in the nation obtained a laser of some sort." The appeal of the new device was so widespread, and yet actual commercial applications so elusive, that the laser rapidly acquired the reputation of a solution in search of a problem. In particular, the millions of dollars disbursed by the military to explore its potential as a destructive weapon had so little result that one cynic exclaimed in disgust that the most offensive use you could make of a laser was to hit someone over the head with it.

The laser is still (judging by the number used in research compared to that in solid commercial applications) a machine with few uses—yet there is no doubt of its powerful hold on the imagination of the technical community. The charm of being able to drill a hole in a razorblade with a beam of light, or bounce photons off the moon, is so great that the actual value of being able to do so is irrelevant.

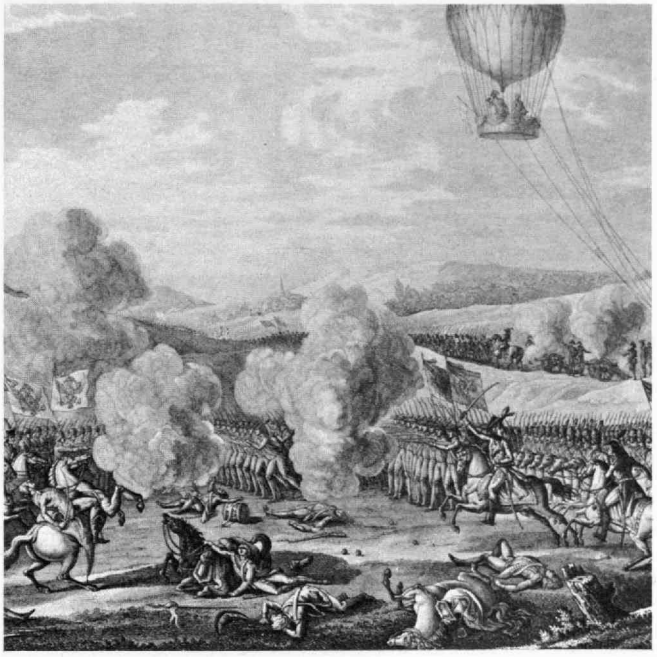
The Military Tradition

These instances of pure technology past and present give an insight into the nature of the discipline. Its central characteristic, like those of art and science, is acceptance of self-imposed challenge and the aggrandisement of the human spirit. It occurs alongside and within applied technology in dynamic and intellectually active societies. It is one of the dramatic arts, and since by and large the human sense of the dramatic is rather direct and unsophisticated, pure technology tends to address itself to naive and, in the fashionable term, charismatic challenges—making large objects go fast, discharging high concentrations of energy, "conquering" space. It is funded on misleading grounds. And behind it, more often than not, lurks the military, like a dim but suspicious creditor, paying up uneasily in the hope of ultimate advantage.

I believe the closeness of the association between militarism and pure technology to be significant. In the convoluted, multidimensional psycho-space of all human mental constructs which it is the ultimate goal of psychology to map, the two are very close together. Both are manifestations of aggression, of dynamic material response to a felt challenge, posed in one case by a like-minded group of people and in the other by Nature herself. In both of them the emotive appeal loosely summed up by the word "glory" is as important as the overt goals. This thesis is implicit in the common claim that the space-race with Russia is a valuable "sublimation" of political rivalries, but it also explains many other features of military history.

Historians have long debated the motives behind the replacement of the longbow by the musket in European

Military application of balloon flight, 11 years after the first balloon ascent: Battle of Fleurus, 1794, in which the French, aided by balloon-borne observers, beat the forces of Coburg. Napoleon, however, had a poor opinion of the new technology. (From L'Homme, l'Air et l'Espace, *by C. Dollfus, H. Beaubois, and C. Rougeron, Éditions de l'Illustration, Paris, 1965.)*



armies around 1600 (see T. Esper, *Technology and Culture,* Vol. 6, p. 382), despite the former's clear superiority in cheapness, accuracy, range, reliability, and rate of fire—advantages it held until the invention of the rifle in the nineteenth century! It has been suggested that expertise in archery declined for some reason after the twelfth century, and that less trainable conscripts had to be used. But the overwhelming melodramatic appeal of the thunderous discharge of gunpowder weapons was probably the key factor.

The same lure of the grandiose is evident in the archmilitarist Prussian tradition. Big Bertha, the enormous gun that shelled Paris from 76 miles away during World War I, was hardly a cost-effective weapon. And the development of the German V-weapons during World War II, ably documented by D. Irving (in *The Mare's Nest,* William Kimber, 1964), is an even clearer instance. V-1, a pilotless aircraft, cost about $600 (then) to produce, whereas V-2, the ballistic rocket, cost $25,500; both delivered about the same warhead (around a ton of high explosive) with comparable range and accuracy. Clearly V-1 was by far the better weapon, comparing favorably in cost-effectiveness with manned bombers. Yet V-2, which replaced it, was far more flamboyant. Irving supports the conclusion of Dr. R. V. Jones, a British intelligence officer concerned with countermeasures to the V-weapons, that V-2 was supported for "romantic" reasons. He describes the overwhelming, Wagnerian impact repeatedly produced on Nazi officials by the ". . . intoxicating sight of the 13-ton rocket blasting aloft atop a lengthening pillar of fire and condensation, and the roar of its motor echoing back over the sea"—and concludes that such military romanticism probably cost Germany the war. Certainly in the later stages of the struggle von Braun's expensive piece of pure technology, by its wholesale consumption of vital raw materials and labor, inflicted far more damage on Germany than it ever did on Britain. As an inhabitant of old London town at the time, it is clear that my attitude should be one of gratitude.

All approved weapons of war seem to have evolved to meet some minimum level of flashing, banging, shrieking romantic appeal. Subsequent developments have given us the doubly dramatic nuclear I.C.B.M., and promise to deliver a still more expensive, problematically effective, but pure-technologically challenging toy, the A.B.M. In *Scientific American* (Vol. 221, No. 2, p. 17) H. F. York outlined the grave drawbacks of this strictly technological approach to security. But what fun to make a missile like Sprint, which goes so fast that its outside gets hotter than its inside! Indeed, one must suspect that the universal opprobrium directed at chemical and biological weapons stems not from any deviation from accepted standards of beastliness or efficacy, but simply from their deplorable lack of theatrical impact.

Static Pure Technology

But not all fields of pure technology are complicated by military appeal. Architectural pure technology, for example, is concerned wtih the grandeur of impressive monuments, rather than of wonderful machines. The most outstanding example may also be the very first—the Egyptian pyramids. Kurt Mendelssohn has argued persuasively from structural and historical evidence that these were not primarily built as tombs to ensure personal immortality for the Pharaohs (though presumably this suggestion was as attractive to the Pharaohs as any hinted prestigious or military implications in a modern grant application), but as gigantic exercises in pure technology, "built because man had reached the stage at which he was able to build them." Similarly one must

The National Aeronautics and Space Administration's parawing was, on this occasion, gravity-launched from a C-119, and attained "steady glide." "The technology developed in the experiments will be applicable to landing future manned spacecraft on land." General Resnier de Goué's parawing, also gravity launched, attained un impeccable vol plané *in 1801. (This engraving of* le Philosophe Volant *is in the collection of Charles Dollfus.)*

acknowledge the considerable pure-technological component in the magnificent cathedrals created in Europe during the ages of faith. But the finest recent example is undoubtedly the Eiffel Tower in Paris. This completely purposeless structure, simply a fine piece of mega-statuary, has become a proud symbol and a focal point of the city. One can hardly imagine Paris without it.

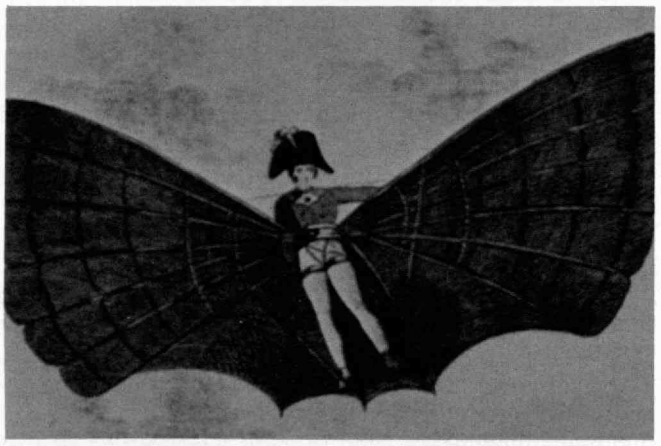
Yet, increasingly, modern architectural practice disdains such overt frivolity, and degrades pure-technological aspirations into commercially respectable but inhuman office blocks. The architect W. W. Frischmann believes that it is now technically possible to build a tower two miles high, so naturally he wants to do it (*Science Journal,* Vol. 1, No. 8, p. 62). But in justification he feels impelled to suggest it as a "vertical city" holding half a million people—thus creating about the most obscene human environment of all time.

What To Do About It

It is clear that the malevolent aspect which pure technology is increasingly assuming stems not from its own proud nature but from our obsession with applications. It would take a brave man openly to deny the grey dogma of our time that all human activity must be economically justified, that nothing should ever be done unless it will return 8 per cent on capital.

The worst consequences of accepting it can, however, be evaded. And it is here, I believe, that the more flexible and devious European mind has much to teach the innocent technologists of the U.S.A. Consider the noble record of the British aerospace industry. A long series of pure-technological triumphs—among them the Princess Flying Boat, the Brabazon super-airliner, the Blue Streak I.C.B.M. and the TSR2 supersonic fighter-bomber—were developed just to the point where the prototype had successfully flown, and were then cancelled (though Blue Streak was kept on in a pure-technological capacity as a space-launcher).

All the satisfaction of dramatic pure technology was gained without inflicting the products on a helpless public or on an already unstable political situation. (I like to think that in the case of Blue Streak and TSR2, the engaging British habit of "leaking" information on such machines to the Russians was designed to encourage them to invest heavily in countermeasures tailored to the weak points of weapons that were in fact purely



hypothetical. But even the devious European mind rarely attains such an Oriental level of duplicity.)

There is every reason to hope that the pattern will be repeated with Concorde. Once the prototype has been exhaustively tested, the program will be cancelled to save money, and peace-loving citizens will be able to breathe freely again. But this civilized technique has only imperfectly crossed the Atlantic. The American counterpart of TSR2, the F-111, was, after prototype testing, procured

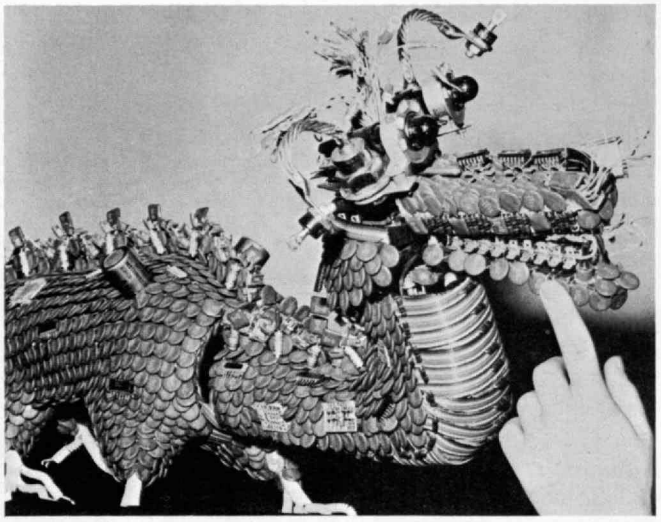
"A dragon that blows smoke and talks through an unseen puppeteer, with eyes that light up and a head that moves, is one of the latest additions to Honeywell's electronic menagerie. The dragon is made up of some 2,500 parts primarily used in computers and was conceived to pose the question to industry: Is your computer a monster?" (Carl Byoir press release). This creature's computer-based comedy routine—featuring lines about, for instance, slipping discs—gathered the largest crowd of any sideshow at the recent Atlantic City computer exhibition.

for the armed forces, to everybody's sorrow. And if the American S.S.T. is once successfully flown, what considerations can hope to arrest it?

We are mishandling the forces of pure technology. We dare not suppress it: for the subjective motivation of every dedicated inventor is basically pure-technological —to rise to envisaged challenge and create objects of pride. The nineteenth-century inventors and engineers understood this; that is why their creations had a style and confidence almost unknown today. The economic prudery which forces the once proud art form to don the respectable mantle of application is now actively harmful, and does much to justify the growing and well-founded dislike of juggernautical technomania.

So pure technology must be recognized and fostered. Even in Britain, one of the world's leaders in pure technology, the stifling doctrine of social relevance and immediate profitability is beginning to clip the wings of the more imaginative and high-flying research projects. I would like to see official bodies set up to protect pure technological endeavor, equivalent in function to Britain's Arts Council. In the United States, this might take the form of a National Pure Technology Foundation. Given such a source of funds, it would be possible to devote one's efforts to seeing in the dark, or making machines that play with building-blocks, or constructing mechanical elephants, without having to waste time on the shaky sophistry of practical application at present required.

Allowing pure technology an honest existence will not only leave certain pure-technologically hag-ridden industries free to return to humane and reasonable techniques (I am particularly thinking of the adoption by the airlines of silent, safe, luxurious, city-center to city-center helium-filled airships) but may also restore confidence in technology among a suspicious populace, and introduce a welcome component of aesthetics into the technical scene at large. But most importantly, pure technology promises to be that "moral equivalent of war" advocated by the great American philosopher William James. Its close psychological affinity to military display may fit it to replace actual combat, just as in the animal kingdom the professional carnivores such as wolves have perfected aggression-rituals which resolve their disputes without bloodshed. Technology has given us the power to exterminate ourselves, and it is fitting



that technology should also provide the safe outlet for our overamplified aggression. Let us hope that the space-race, that triumph of pure technology, may be an archetype of triumphs to come!

Suggested Readings

Plato, *Republic,* Book 2, pp. 357a ff. K. J. Dover trans.

J. Mander, G. Dippel, and H. Gossage, *The Great International Paper Airplane Book,* Simon and Schuster, New York, 1967.

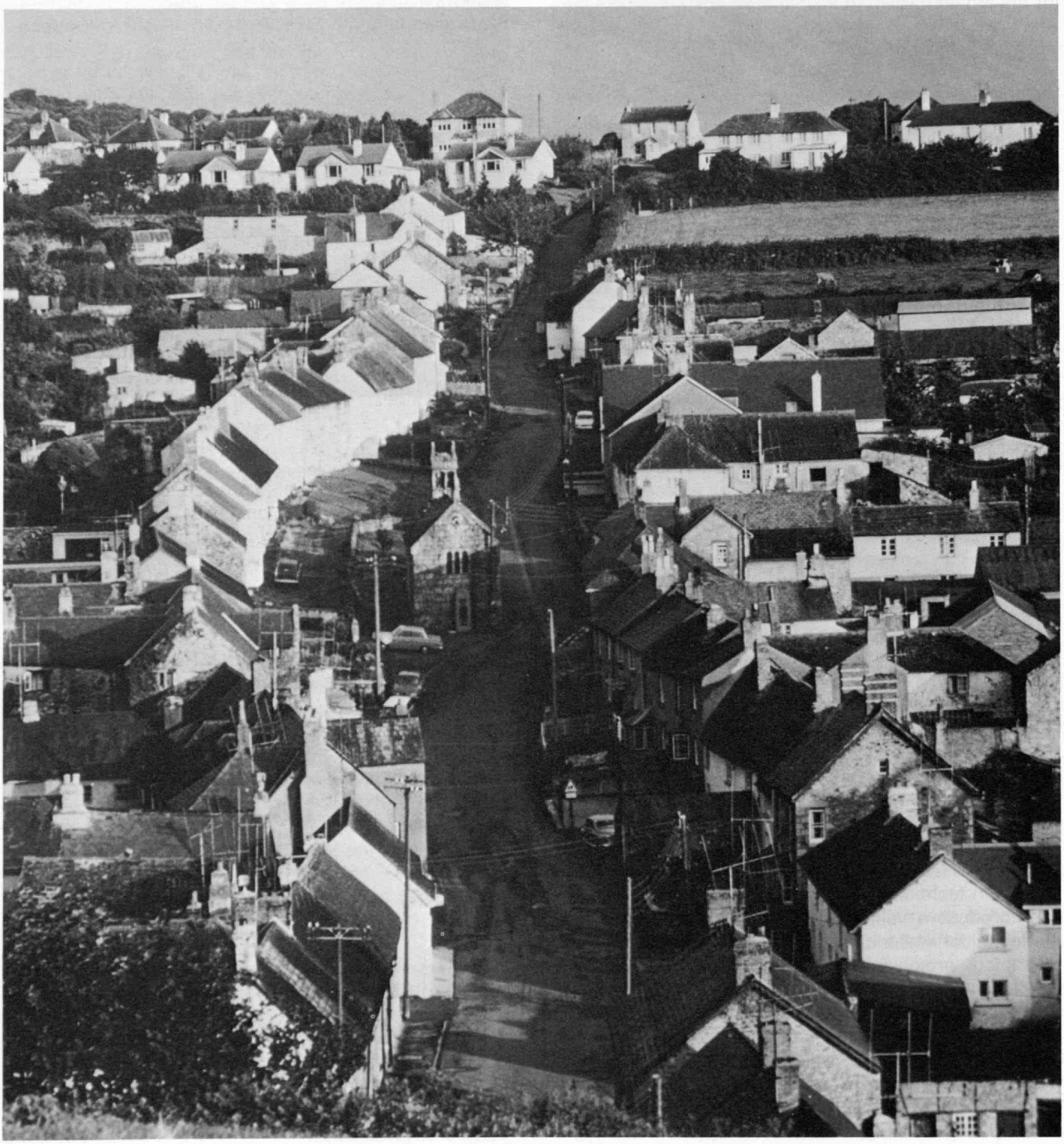
Hero of Alexandria, *A Treatise on Pneumatics,* section 15 ff. Bennett Woodcroft, ed., Lord, 1851.

K. Mendelssohn, *Science Journal,* Vol. 4, No. 3, p. 48.

K. Lorenz, *On Aggression,* Methuen, 1967.

"Daedalus" is the inexhaustibly inventive columnist of the British journal New Scientist. *He is known to be a friend of the labyrinth-consultant Ariadne, on whose page his work appears each week, and to be the Research Director of the fabled Daedalus Research, Evaluation and Development Corporation (DREADCO).*

South Zeal is a small village on the edge of Dartmoor, in Devonshire. It exhibits—without suffering seriously from them, yet—the issues before many British towns: how to preserve the picturesque antiquities of the main street in proper relation to the contemporary, less picturesque housing of the post-World-War-II era.



Two different traditions in city planning, the British and the American, trade off experience and philosophies so each may produce better in the current wave of planning

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British Town Planning in Transition

British urban planning is characterized by an action-oriented approach that is reflected in a long history of the practical application of physical planning intervention. Though this intervention in the urban situation has been marked by sincere concern for the functions of the physical environment and by a genuine social motivation, its basis of theoretical and research understanding is slight. There has been little impetus to developing understanding, for planning has been cosseted by a climate of political acceptance that has shielded the planner (and his values) from public debate and has promoted a vast amount of enabling legislation to maintain his position of authority. Conversely, security has reinforced the profession's own value convictions, leading it to pay too little attention to the market, for example, as an expression of public preference.

The paucity of understanding needs to be emphasized. One constant belief, almost a theory, is that action in the physical environment has a necessary, and often sufficient, sociocultural effect: this is the belief in the beneficial effect of bricks and mortar; this is physical determinism, that imbues the physical resources that the planner controls with a high degree of significance. But the times are changing—rapidly, and often as a result of American influences.

American planning is, in contrast, much less of an applied discipline. Where it has been involved with action and implementation, it has been subject to greater pressure from political interests and the demands of the market. And it has not had the advantage of either public acceptance or legislative backing. Though the physical environment is the same, the situational differences in the political context of planning practice have encouraged a technically efficient rather than a value-based approach. Planners have had to work within the system without changing it: the use of zoning techniques provides a good example of planning as adjunct to the market.

In the area of theory building and research, however, the picture is quite different. Here liberal university support and the general abstraction from realities of action are reflected in a sophistication of concept and techniques that outstrips practice. But the stage is set, in the form of an urban crisis, for testing the relevance and applicability of much of this work: one aspect particularly appears to be guiding approaches to the new urban planning and thus the techniques that it adopts.

This is the idea of comprehensiveness, which is inclusive rather than just physical, spanning the total range of metropolitan-scale facilities: it integrates health, education, welfare, and other social services with physical intervention; it then ranks each kind of intervention according to importance in a given planning situation, and determines the most salient mixes of services and physical planning. Theoretically it puts physical determinism in its place by demanding research into the nature of urban processes and problems so as to decide the most pertinent forms of intervention: job training may be much more effective than new houses as a generator of desired social change, for example. The idea partly derives from experience in American housing programs in the 1950's and early 1960's and is reflected most explicitly in the Model Cities program, which aims at both individual and physical development by offering a comprehensive panel of resource allocations.

The History of British Planning

Urban planning in Britain has a centuries-long history, but the past hundred years, beginning with the rapid urbanization of the mid-nineteenth century, is most pertinent to present planning tasks. It is useful to review this period briefly, for it reveals patterns of planning activity which suggest the directions that both American and British are, or should avoid, taking.

The growth rate of Victorian Britain was phenomenal: in 1800 the population was 10 million and in 1900 it was 37 million; by 1830 the present-day population pattern of Britain was fixed, and from 1850 to 1900 the number of cities of 5,000 or over grew from 100 to 250. A process of citification concentrated large populations in urban areas based on industrial employment, and produced the classic Dickensian slum conditions of overcrowding, poverty, heavy mortality, and criminality. The late 1800's is the era of the great reformers, and those concerned with physical environmental reform were among the most zealous; fundamental to all their efforts was faith in a causal relationship between the physical environment and individual and group behavior. With true Victorian highmindedness they proclaimed the benefit of a new environment on moral and social as well as physical life.

Three approaches to reform can be categorized: renewal of the city from within, building new towns, and city expansion. The first achieved only small-scale results; the second took the form of the Garden City and became a vital ideology of British planning, but the third was the real shaper of urban form. In 1898 Ebenezer Howard published a book called *Garden Cities of To-morrow* that set out a plan for clusters of small cities of 30,000, each surrounded by a green belt. A return to a symbiotic relationship with nature and an assertion of the socially regenerative effects of a high quality physical environment are essential features of the Garden City thesis. Though the idea caught the public fancy it was minimally applied. Instead the environmental character was grafted on to new "garden suburbs" that expanded along the new intracity railroad lines.

From 1900 to the 1930's, planning can be characterized as the control of and layout of residential suburbs. Though it gained a degree of practical experience, no sophisticated theoretical basis was laid, and much of the Victorian zeal was lost. It became, as in America, no more than a technical exercise in minimizing conflict between land uses and structures.

After the Second World War, public optimism, which has been described as close to utopian, revived a demand for planning and the "rational determination of the physical environment." Following the Victorian model, planners adopted the role of reformers, and became the idealist regenerators of the physical, and thus the social, urban milieu. The postwar response to urban crisis is a repeat performance of the Victorian history, and the conceptual approach in which the physical package was bound up by a loose-knit social theory mimics the previous era. It is perhaps in New Town building, designed to relieve population pressure on London and move communities out of war-damaged areas, that these features are most clearly displayed.

The New Towns are an important early regional planning essay in control of metropolitan growth and industrial location that has been wholly successful, though on too small a scale. But it is the urban structure of the cities themselves which is most revealing of the intent of postwar planning. Implicitly, the benefit of a low-density limited-size garden city (like Howard's) to the social life of its residents was assumed; explicitly, a social intermixture of all class groups (with the upper class providing social leadership) and a physical structure based on neighborhood units were supposed to generate instant social community. The neighborhood units were borrowed, by the way, from the New York Regional Plan of 1929 in which Clarence Perry theorized that when "residential communities meet the universal needs of family life they have similar parts performing similar functions": by turning the relationship around he claimed that physical units providing all the necessary schools, shops, open spaces, and access would lead to social cohesion and community. British planners borrowed the neighborhood theory and used it in New Towns and in restructuring existing cities.

In the event, this first importation of American theory proved invalid, as did the context of social intermixing. Though a variety of social groups was achieved in the New Towns as a whole, at the neighborhood unit level they separated out, to create distinct upper and lower class units. And within the units community life did not result from or conform to the physical pattern: rather it proved to be a diffuse pattern of social connection between many units and also outside the urban area. The *reason* for emphasizing these failures is that crude physical determinism in relation to social goals is now no longer tenable as an explicit advocacy for British planning, though its ghost haunts the convictions of many urbanists. The *lesson* is that if the current resurgence of planning, which follows a period of planning inactivity in the 1950's after the main work of war reconstruction, is to be interpreted as the beginning of a third spate of zealous contribution to the urban environment, then it is clear that a more sophisticated understanding of urban processes must condition this zeal. Failure of American theory has pointed up the need for research and theory building, in which America is currently more advanced.

Predictions of a contracting population growth rate, as well as less obvious need for physical renewal, dulled the euphoria of the late 1940's. The 1950's saw little activity, but in the early 1960's, social and technological changes, as well as new predictions of population growth, encouraged a third planning renaissance. A surge of New Town building resulted (see page 50) and a new wave of urban planning is under way. Before reviewing the present situation the historical experience should be summarized, for it holds, it is argued, clues to the pattern that current and future work will take.

It is a see-saw history, which suggests that action-oriented planning is not independent of public and political appreciation of the need for environmental control: planning has gained responsibility following political reactions to urban problems and crises. Further, to lose that responsibility, planning need not fully resolve the problems which promote it, but need only dull the edge of stress. Because of a discontinuous and inconstant pattern of planning activity in Britain there has been no consistent build-up of research and theoretical expertise. Thus the eager attempt to respond at the points of peak demand for planning has only been able to rely on an ill-formed basis of understand-

ing, and this may have prejudiced the very success which is sought at these times. To break the historical pattern at this third opportunity will need a basis of theory and research which is, in turn, most difficult to evolve out of the kind of discontinuous history that already characterizes British planning. In contrast American planners enter their first peak of action planning with a more rigorous background of theory and research, and may thus be able to break any incipient cycle of discontinuity: if British planners appreciate the lessons of their own history, the value placed on imported American know-how is likely to be high.

A personal conviction is that much of the vitality of American planning stems from its experimentation and fermentation in a period of minimum professionalization. British experience shows that planning uses its new-found authority, in response to crises, in order to establish professional status: it seeks legislation and begins to attempt a definition of aims and codes. Yet in the fast changing and undefinable complexity of urban affairs this is the very kind of response that fossilizes the profession: much effort has been spent at each activity peak in refuting the already ensconced position of the profession.

1970's: New Aims and Techniques

Some of the gross changes that set the context for a third peak of professional activity are: new production techniques; increased general affluence and a new social mobility that has broken down some of the rigid classification of British society—without destroying its diversity of persons and groups; technological change that is most explicit in the demands and effect of automobile use; and changes in life patterns that have tended to disperse social contacts and emphasize physical mobility (such patterns are by no means as common as in America, but are prominent, in contrast to the well-rooted tradition of locally based activities and interests, especially in the many smaller cities). All this is in the context of population expansion in a small and already densely populated country: because affluence and social change are being reflected in a demand for more residential space per family, Britain could become the world's first suburbanized country—a distinction that its size can ill afford.

Many of the problems confronting planners as a result of these changes and pressures will be familiar. Some are, generally, the basic planning problems of resolving conflicts in demands for the use of urban land, the congestion effects and the distance costs of population growth set against a high demand for accessibility; and specifically, air, river, and land pollution, social and mental health problems, the disruptive scale of automobile movement, and the quality of the environment. Britain differs from America only in the stage of evolution of many of these problems. Thus it is comparatively recently that affluence has resulted in real problems of vehicular movement, and only now is the pattern of future social problems—of sub-culture groups, crime and delinquency, and the growing problem of race in new immigrant communities—being appreciated.

It seems that London may be following the American pattern of social polarization: a city housing the rich who can pay the costs of urban center congestion, and sheltering the poor who rely on city center employment. The middle classes are leaving and changing the social and environmental character of the city. Where, before, the New Towns and the expansion of existing towns on the metropolitan fringe were seen as only additions to London to take its overspill population, they now appear positive alternatives to the city.

And New Dilemmas

The planner is now faced with two dilemmas: how to perceive and comprehend the needs of a now more complex urban situation without the benefit of prior research and theory upon which to base understanding; and how to work with physical means of intervention without an acceptable understanding of the effects of that intervention—the convenient physical determinism of the Neighborhood theory has been disproved. To resolve these conflicts, planning appears to be adopting a strategy of reactions to clearly apparent problems, on the assumption that these are sufficiently indicative of the total picture of urban needs, and to be concentrating on research into these problems that will lead to a new *induced theory* of the environment. It appears to be abrogating some degree of its responsibility for the overall situation, while developing inductive methodologies for getting to grips with selected problems. This latter development, of research into problems, is a particular innovation, for, whereas postwar planners *deduced* simplistic concepts based on their own values and implemented these dogmatically, the new approach is to understand by empirical study, using research and, most important, a participating public.

Meanwhile, a problem-solving approach is involving British planners in understanding the characteristics of the new urban situation: problem complexity, problem interdependency, and a problem variety that includes a wide range of subjects. Thus, planners are stressing the need to be both comprehensive in concern and integrative in ability, and new technical skills are evolving rapidly to enable them to accommodate and interpret new kinds of urban data. Many of the techniques are imported from America and are based on computer technology and system building that can help organize and analyze complex, even conflicting, information.

Britain's post-World-War-II experiments with New Towns may be divided into two periods—one immediately following the War, as part of the effort to replace housing units destroyed by German aircraft and missiles, and one beginning in the 1960's under a new wave of interest in urban planning and conservation, coupled with predictions of population growth. Despite this and earlier background, says the author, "there has been no consistent build-up of research and theoretical expertise. . . . To break the historical pattern (now) will require need a basis of theory and research which is . . . most difficult to evolve out of the kind of discontinuous history that already characterizes British planning."

These changes of approach and technique are underwritten by legislation and (pending) administrative reform measures. Legally, the 1968 Town and Country Planning Act provides for two kinds of urban plans, *structure plans* and *local plans*. Structure plans cover the whole urban area: in preparing them the planning process gives priority to research and analysis of trends and issues that underlie social, economic and physical problems of the environment, and the whole process is set in the context of public participation. The plans are consciously strategic and thus adaptable: they are designed to allow on the one hand for flexibility of goals and action over time as changes occur in problem characteristics, and on the other hand for expression of individual choice and preference within their broad guidelines. In these respects they contrast with the old style *development* plan which encouraged static, detailed and finite plan making in which there was little room for change or public/market contributions.

Local plans deal with areas of up to 50,000 population and are designed to be a positive contribution to the environment: larger scale units of physical planning—of roads, housing, etc.—are encouraged by the new Act and are to receive extra government support. There is a curious incongruity between city-scale strategy planning and the new local commitment to large scale action-oriented plan making, for a sensitive local environment of the future may well be one in which there is *strategic freedom for involvement and for social expression and adaptability,* taking place in the context of real public participation. The tradition of physical building dies hard: there may be a need for strategic guidance without detailed plan making at the local scale as much as at the city scale.

Legislation and Beyond

The 1968 Act is perhaps the most fully developed form of planning legislation in the world. It is not thereby the most sophisticated; rather there is a need to develop ideas and techniques, of strategic planning or integrated Model Cities-type planning, for example, within its structure. It is interesting that as a result of sponsoring legislation, in 1947 and again in 1968, which promotes extensive rather than sophisticated planning, the British system presents less impetus to the kind of innovative qualities that are characteristic of much direct action (not legally backed) in the U.S. America.

Group I and II New Towns

Regional location	Start date	Name	Population 1967	Population 1981 projected
Group I				
South East London decentralization	1946	Stevenage	57,000	79,000
	1947	Harlow	70,000	112,000
		Crawley	63,000	93,000
		Hemel Hempstead	67,000	79,000
	1948	Hatfield and Welwyn Garden City	67,000	79,000
	1949	Basildon	70,000	103,000
		Bracknell	26,000	59,000
Midlands	1950	Corby	46,000	72,000
North East	1947	Aycliffe	17,000	45,000
	1948	Peterlee	20,000	32,000
Scotland	1947	East Kilbride	62,500	86,000
	1948	Glenrothes	26,000	60,000
		Totals	631,500	893,000
Group II				
Scotland	1955	Cumbernauld	24,000	70,000

Group III New Towns

Regional location	Date of designation or report	Name	Population 1967	Population 1981 projected
South East	1967	Milton Keynes	40,000	121,000
	1966	Ipswich	121,000	219,000
	1966	Peterborough	78,000	175,000
Midlands	1964	Redditch	29,000	73,000
	1966	Dawley-Wellington-Oakengates	68,000	200,000
	1966	Northampton	122,000	222,000
North East	1964	Washington	20,000	70,000
North West	1961	Skelmersdale	13,000	70,000
	1964	Runcorn	29,000	77,000
	1967	Warrington-Risley	127,000	180,000
	1967	Central Lancashire	250,000	412,000
Scotland	1962	Livingston	8,000	50,000
		Totals	950,000	1,869,000

has a tradition of helping by involvement which the apparently all-seeing but in fact somewhat stifling fullness of British legislation tends to preclude: the very existence of extensive legislation encourages the belief that enough is being done both qualitatively and quantitatively and it prejudices the professional perception of the need for continuous re-investigation, and for creativity and innovation. The work of newly formed groups such as Shelter, which is nationally known for its work in helping the homeless, is beginning to establish a new trend of direct involvement in problems to which bureaucratic planning is slow to respond. Recent work is reminiscent of the Victorian reformers who started innovatively without preconditioning legislation.

Pending reforms in the administrative context may advance the pace of development along these lines. The Maud report (summer 1969) is now before Parliament; it suggests a series of new city-region authorities that will rationalize a multiplicity of existing agencies and co-ordinate the planning of groups of proximate cities. Smaller, more isolated cities will come under new county authorities. In both cases local councils will counterbalance the larger authority. Finally, and most important, reorganization within the new authorities means that physical planning will be coordinated with other kinds of environmental services, notably in the social field.

Thus the new larger and coordinated organization will offer opportunities for a new specialist planner, especially in the fields of research and planning techniques, and on the subject of strategy planning. And, vitally important (this needs repetition), the new links between departments in the authorities will set the scene for an integrated, balanced, and publicly sanctioned program of environmental intervention. This will permit the kind of comprehensiveness in planning which this paper has suggested to be incorporated in the Model Cities program. A new form of interdisciplinary policy planning will develop that establishes the mix and programming of various interventions in each planning situation. The implication of these local government reforms lies in the opportunity for a coordinated and sophisticated planning that can be applied at a much broader scale than applies, say, under Model Cities legislation: because this is the *modus vivendi* of the whole structure of British planning it is sure to attract the kind of support that ensures success in implementation.

The implication for participation is that the public can express real priorities by opting for, say, social versus physical planning, instead of being asked to participate within the limited choice situation of only selecting from amongst different physical interventions.

Of Current Concern: Conservation

Britain's urban pattern is largely historic, and alongside the need to plan for new development is the need to improve existing environment in which some special character already exists or can be readily achieved. Against this background the Civic Amenities Act of 1967 provides powers for positive conservation—preservation combined with upgrading in areas of architectural or historic interest. So far 220 areas have been designated and 3,000 are eventually expected; they range from ninetheenth and early twentieth-century town centers to rural villages. In these areas controls are imposed on the nature of further development, and there is a variety of schemes incorporating, for example, street improvement, tree planting, and removal of visual eye-sores.

Many of the most rapidly growing British cities are middle-sized historic settlements. In this context conservation is much more than a romantically inspired cosmetic exercise. Rather it begins to deal with the essential continuity of development in urban areas under major pressures for change.

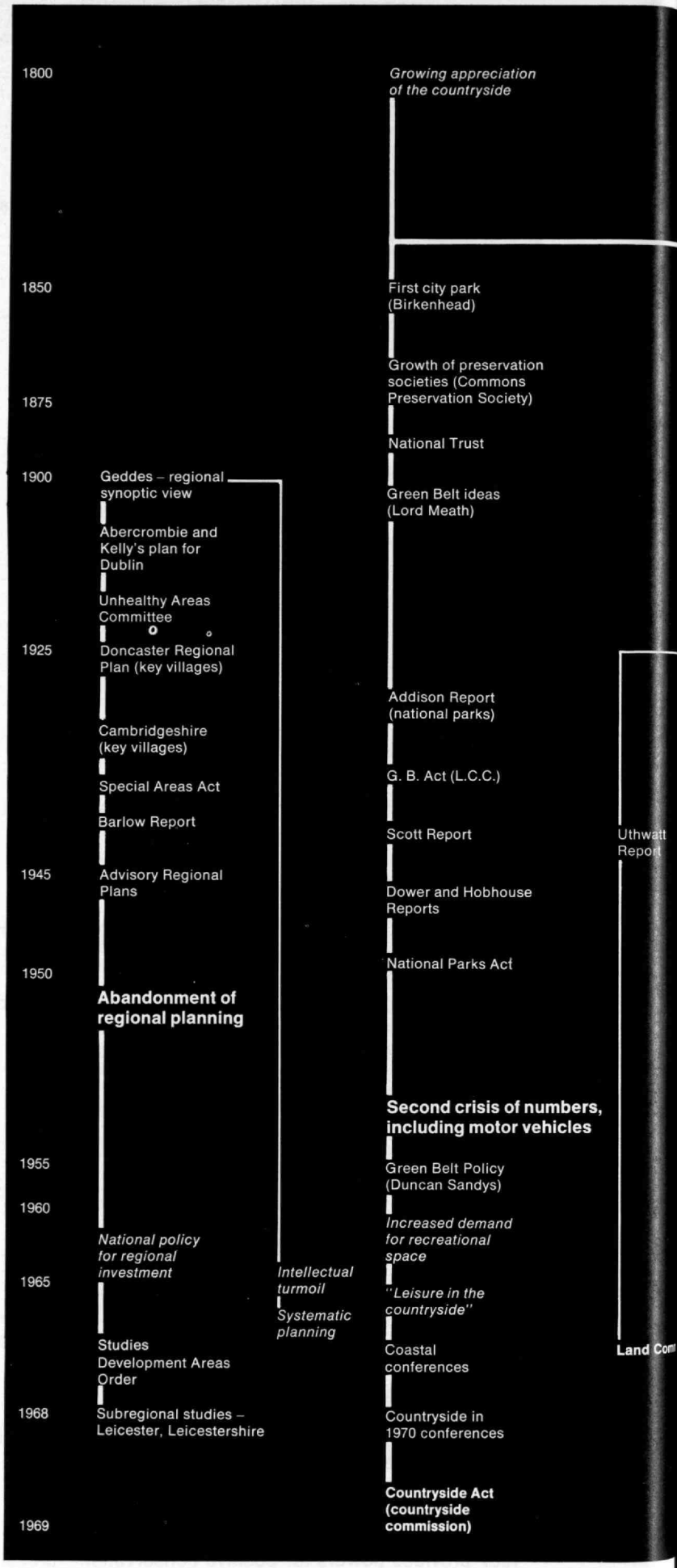
Housing and Housing Policies

The historic context is reflected also in the housing problem, and the historic legacy of housing has an important bearing on the way the problem is presently perceived and acted upon. (In preface, where reference is made to public housing, this is not to a small number of houses nor to housing with a social stigma. The public sector accounts (1964) for 26 per cent of the housing stock, with only 46 per cent owner occupiers, and 28 per cent of other tenancies. The current trend is to a significant increase in owner occupation).

Housing projections show a housing surplus by 1973, with a 5 per cent margin that is needed for mobility and orderly working of the market. But this gross statistic neglects the quality of the housing stock, which includes a vast number of older houses. In 1961, 46 per cent of houses had been built before 1919 and 77 per cent before 1945, and a recent survey (1967) showed nearly 40 per cent of the 16 million houses in Britain to be in need of improvement, largely because of the effect of age. Each year accelerates the decline.

This historic backlog has encouraged research into the feasibility of rehabilitation to bring about marked improvement and stave off the moment for complete renewal. Economic analysis has shown that instead of investing in a new house with a 60-year life, many older houses can be improved at half the cost, allowing a new house to be built with the residue which will have increased in value (by investment) over the 20 to 30 years of extra life gained by improvement. Social advan-

The evolution and "officialization" of British town planning (freely adapted from "Planning Ideas", by J. M. Wright, Journal of the Town Planning Institute, December, 1963). Abbreviations: T. and C.P.—Town and Country Planning; G.B.—Green Belt; L.C.C.—London County Council; Mark 1, 2, 3 and 4 New Towns—equivalent to the groupings in the table on page 50, except that Group 3 is here subdivided.

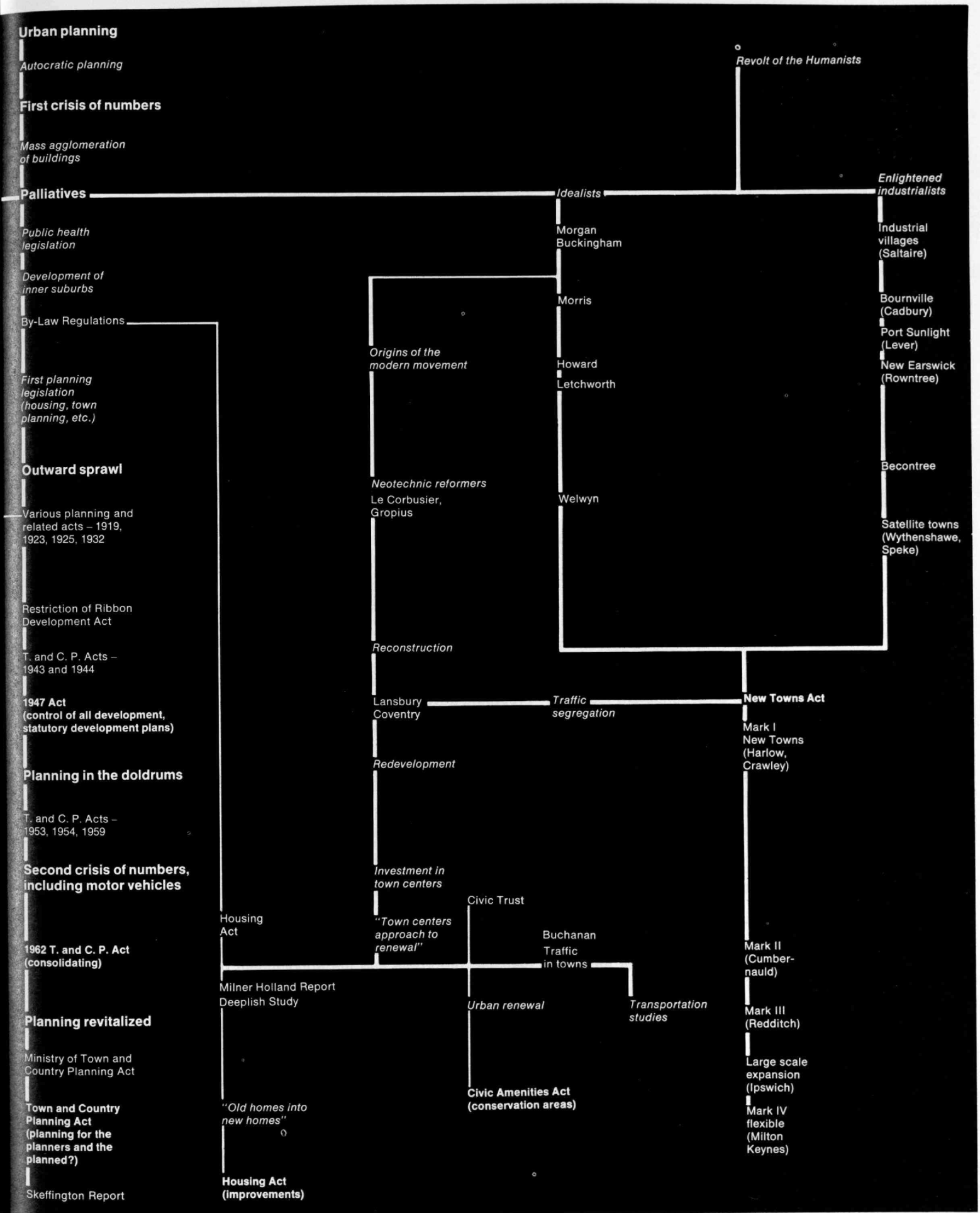


tages of only gradually disrupting communities, by the use of phased renewal combined with rehabilitation, have been instanced. And the visual continuity of phased change has been stressed. The result is that public authorities are looking toward rehabilitation with real and possibly overenthusiastic interest.

For the private owner a new Housing Act (1969) provides generous grant aid to improvement and, most important, sets out a new code for local planning and housing authorities to work with local residents by giving advice and improvement loans, as well as an extra subsidy for external landscape amenities (including car parking spaces, lighting, etc.). In the region of 200,000 home improvements per year are expected under the Act.

Somewhat incongruously, this effort toward improvement may prejudice the overall housing situation. It is known that in the early 1970's Britain's population growth and household formation will slow down sharply so that fewer new houses are needed: the number of new families and needed homes will pick up again in the late 1970's. Thus the 1970's will see a period of slack in the construction industry which could be used positively to build houses and infrastructure services that would largely solve many of the environmental problems of the 1980's. But instead of using this opportunity authorities appear to be using decreased demand as an excuse for economy—public money is short at present—while at the same time using rehabilitation work—which is relatively cheap—as evidence of their continuing concern for housing.

Another aspect is that much housing is not of the right kind nor in the right place. In larger city centers the housing problems of the new poor are acute and have received national press and television coverage involving harsh recriminations of local government agencies. The new poor are large families dependent on less skilled central area employment, the old who remain in houses that are often too large and poorly maintained, and the burgeoning population of low-skilled Black and Asian immigrants; because of our curious system of tax and other economic disincentives to both private and public landlordship all these groups are faced with a contracting supply of the kind of accommodation they require, namely rented accommodation and specially built public housing. Any available accommodation is highly priced, often overcrowded, and in poor repair.


Urban planning
Autocratic planning
First crisis of numbers
Mass agglomeration of buildings
Palliatives
Public health legislation
Development of inner suburbs
By-Law Regulations
First planning legislation (housing, town planning, etc.)
Outward sprawl
Various planning and related acts – 1919, 1923, 1925, 1932
Restriction of Ribbon Development Act
T. and C. P. Acts – 1943 and 1944
1947 Act (control of all development, statutory development plans)
Planning in the doldrums
T. and C. P. Acts – 1953, 1954, 1959
Second crisis of numbers, including motor vehicles
1962 T. and C. P. Act (consolidating)
Planning revitalized
Ministry of Town and Country Planning Act
Town and Country Planning Act (planning for the planners and the planned?)
Skeffington Report
Revolt of the Humanists
Idealists
Enlightened industrialists
Morgan Buckingham
Morris
Howard
Letchworth
Welwyn
Industrial villages (Saltaire)
Bournville (Cadbury)
Port Sunlight (Lever)
New Earswick (Rowntree)
Becontree
Satellite towns (Wythenshawe, Speke)
Origins of the modern movement
Neotechnic reformers
Le Corbusier, Gropius
Reconstruction
Lansbury
Coventry
Traffic segregation
New Towns Act
Mark I New Towns (Harlow, Crawley)
Mark II (Cumbernauld)
Mark III (Redditch)
Large scale expansion (Ipswich)
Mark IV flexible (Milton Keynes)
Redevelopment
Investment in town centers
"Town centers approach to renewal"
Civic Trust
Buchanan Traffic in towns
Transportation studies
Housing Act
Milner Holland Report
Deeplish Study
"Old homes into new homes"
Housing Act (improvements)
Urban renewal
Civic Amenities Act (conservation areas)

Research, Techniques, and Consultancy

The sophistication of research and technique development in America is the result of several factors. It has been encouraged as alternative to the practice and application of planning and by the need for more rigorous justification, both politically and publicly, of any planning work that is undertaken. And the context of funding by universities and foundations has encouraged a varied interdisciplinary background of contributions. The importance and lessons of this work and the need for other than architectural or engineering backgrounds to planning has made a marked if somewhat delayed impression on British planning in the last few years, both in the adoption of techniques and the setting up of research centers for urban studies. As yet such centers are poorly supported, however—government grants run at $0.45 million per year compared with $125 million for scientific research.

It would be interesting to know if American universities are to be praised for their support of urban research over the last decade or so. Were they percipient judges of the present urban crisis? Their predilection for, say, research into mathematical models of transportation systems that can be applied simply to facilitate urban growth without any kind of normative reform suggests not; and indicates that they preferred to support planning as a technical adjunct to the market rather than as a value-based exercise.

The British-adopted research findings and techniques are being applied to all stages of planning, from survey and analysis to policy and plan formulation; and the American studies of the planning process itself have made British planners more aware of their political role and of the implicit values in their work. Many of the techniques center around computer technology and systems analysis which are only now finding sufficient skill and financing to warrant their use here.

Research has been adopted via several channels: the direct interchange of personnel between the two countries has been a vital connection (American planning journals are also important and deserve research as agents in planning professionalization); and indirectly, in social work for example, British universities have taken transatlantic cues and subsequently passed these on to the British planner. Consultancy work is likewise important, and American firms have for some time been regular bidders for major planning and transportation studies.

In the reverse direction a traffic in the use of British consultants is developing, mostly because of their action experience and known social objectivity and commitment. British consultants are now working in New York, Detroit, Los Angeles, Toledo (Ohio), and Washington. The group working in Washington has hired an American sociologist to live and evaluate the suitability of their high-density housing in London for the American market: thus British work, a live experiment, is being used as a pre-test for American application. Another firm involved in Detroit has been hired to help the community make a stand "in the face of the approaching bulldozer": this is quite a role reversal—it involves a change from being part of a highly developed and accepted planning system to being an advocate against a less sensitive one. The experience may well lead the planners to look anew at the nature of the British system and at the social potential for community participation in preparing advocacy plans.

Public Participation

The current effort toward greater participation in planning asserts that the citizen should and can be involved in public decision making. Criticism of the British planner's personalized values, and of the fact that large areas of decision making were inadequately supervised, declared the need for participation, and appraisal of the American experience of citizen involvement over the past decade suggested that it could be successfully operated. A government report (July 1969), partly incorporated in legislation, has recommended the setting up of local community forums as sounding boards for planning proposals and the appointment of community development workers to determine the views of "non-activists." It also encourages the use of press, radio, television, public meetings, etc., to keep the public informed of decisions and available planning information.

Though participation exercises are under way, it is too early to judge their effect on the plan as a product. The fascinating part, however, is the speed with which participation has been accepted as a value in British planning; this paper has argued that as a value it is an essential adjunct, a vital information source, to the new emphasis on understanding the urban social complex through research. In contrast, the American experience

is much more extensive, yet participation has for the most part remained as a strategy—a strategy of opposition which forces planning agencies to consult with the community: a strategy that has led to hiring British planners as advocates of opposition.

This use of participation as a strategy of organization to exert political pressure has tended unfortunately to stress the process of confrontation rather than the information that might be exchanged. But it has given rise to a subsidiary form of intervention which has important consequences for the planning situation in question. It has led to social and community workers using the opportunity of organization for social engineering to reshape the very factors—such as lack of cohesion, poor job skills, and delinquency—with which planning is concerned: thus the process of participation can become as important as the end purpose in planning terms. British planning, perhaps because of its experience in the role of provider of physical goods, has not appreciated the social concomitants and opportunities in organizing for participation. But there are indications in new government programs of greater interest in this direction, and the American influence is clearly discernible.

Participation as a value could have led to the public being absorbed as yes-men into the planning machine. But this has not happened. Already London's highway planners, for example, are facing remarkably articulate and effective opposition from local pressure groups.

Conclusion

The late 1960's can be viewed as a period of transition, ending a second generation of planning and opening a third. The second generation began with postwar zeal and floundered in public apathy in the 1950's and early 1960's. A new generation of planners, aided by American work, may now be well enough advanced to break the see-saw discontinuity of past history.

To do so they must remain practical, but must also develop a theory, using public information and research which embraces present problems as well as a wider spectrum of issues. Theory should lead to the identification of incipient problems and rank them vis a vis existing ones. Perhaps it will, over time, allow a consensus vision of the future, and identify some of the obstacles involved in its realization: these obstacles might or might not match present or incipient problems. No matter how refined the new planning is, it will deal more with social issues, both general ones of freedom and the expression of choice and specific ones such as housing inequalities and race. It will relate physical planning to other forms of intervention and decide the relevance of either for different urban situations. It will carry out physical planning at larger scales with positive goals for a psycho-socio-economically satisfying environment.

Similarities of problems and of professionalism will encourage increased exchange between Britain and America.

Suggested Readings

Thomas Blair "Poverty of Urban Planning," *Official Architecture and Planning,* March, 1969.

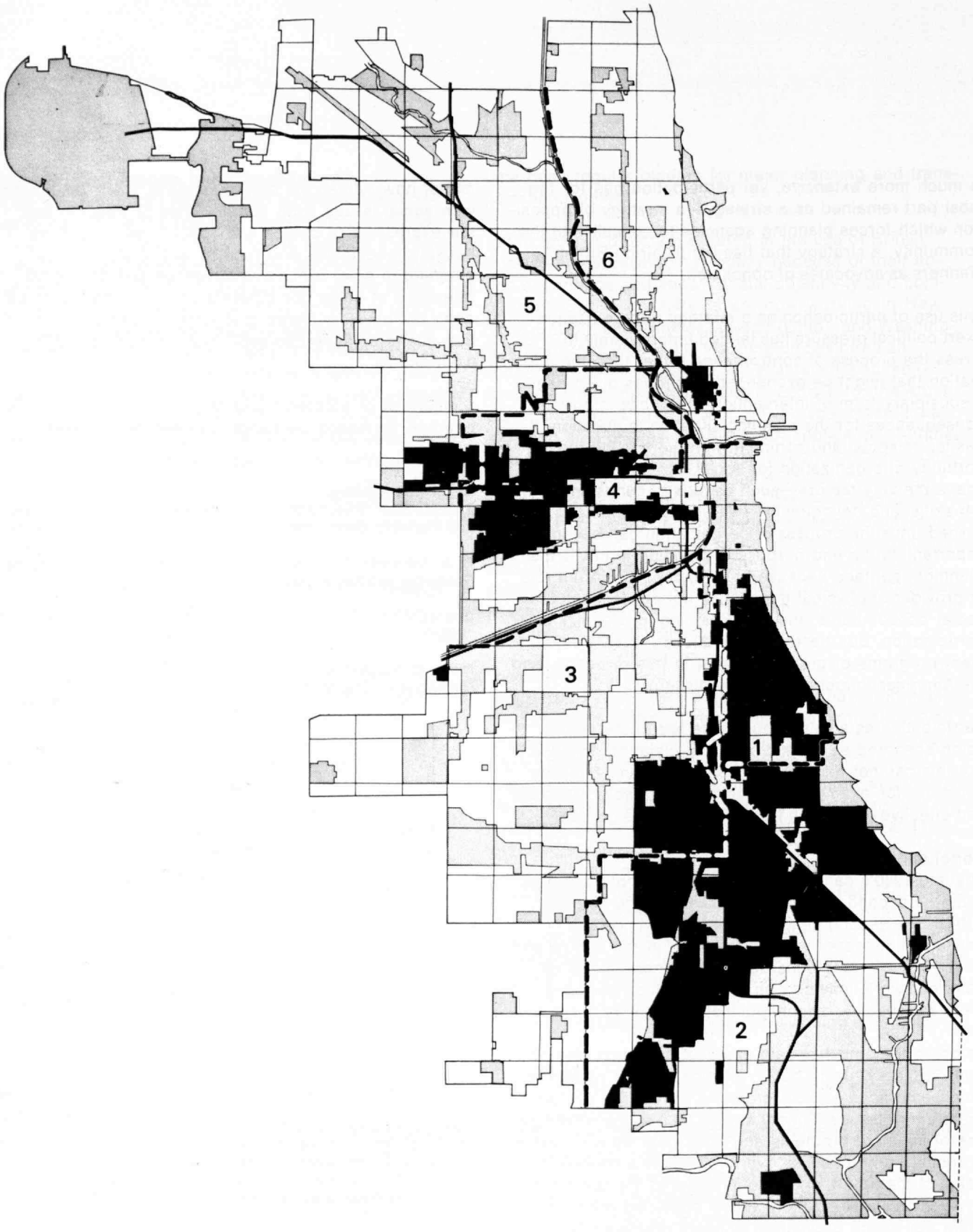
G. A. Ashworth, *The Genesis of Modern British Town Planning,* Routledge and Kegan Paul, 1965.

Ebenezer Howard, *Garden Cities of Tomorrow,* Faber Books, 1962.

Planning Advisory Group, *The Future of Development Plans,* Her Majesty's Stationery Office, 1965.

Trevor MacMurray holds both a degree in architecture from Edinburgh University and one in city and regional planning from M.I.T. He has worked in redevelopment, site, and area planning in Edinburgh, Belfast, and Cardiff. His present interests include investigations of housing preferences, self-help housing (and its implications for the planning process) and the economics of alternative housing policies.

The dark areas on this map show parts of Chicago in which 25 per cent or more of the dwelling units were occupied by nonwhites in April, 1969. Their gradual expansion throughout the central city is more important for police planning than their extent; the author points out that tensions accompanying change in a neighborhood are a special source of law enforcement problems. (Map: Chicago Police Department)



The only thing wrong with the present scheme for distributing motorized police around the city is that it does not work. The methods of operations research allow alternative strategies to be worked out and evaluated

Albert M. Bottoms,*
D. G. Olson,
E. K. Nilsson
Operations Research Task Force,
Chicago Department of Police

Operations Research in a City Police Department

Every American city is experiencing rising demands for police service. In Chicago major crime is increasing at the rate of about 5 per cent per year—well below the national average of 18 per cent—but overall demands for police service are increasing at the compound rate of 10 per cent per year. The communications center of the Chicago Police Department is routinely handling more than twice its design capacity of calls. The motorized beats and other patrol elements are approaching the limit of the amount of service that they can provide. Something has to be done.

The Operations Research Task Force of the Chicago Police Department came into being in February, 1968, as a result of a grant from the U.S. Department of Justice. It consists of four civilian operations research scientists and seven Chicago police officers, who were specially selected for this assignment and were given additional preparation in a nine-month course at the Northwestern University Traffic Institute.

That there is enormous potential use for operations research and systems analysis in deciding how to allocate the resources of a major law enforcement agency was a major conclusion of the President's Crime Commission. The purpose of the Chicago grant was to provide a demonstration of how operations research could in fact improve efficiency in allocating patrol resources. A second objective was to test the viability of an "in-house" operations research group in a Police Department, and a third was to indoctrinate selected police officers in the uses of operations research.

The police administrator needs specific recommendations for courses of action that are within his capability to implement. The recommendations must recognize political, budgetary, manpower, social, and psychological constraints. The operations researcher must be aware of the impact on the entire system (community—criminal justice—police) of any recommendation he makes regarding manpower allocation.

What follows is a summary of approaches, findings, conclusions, and recommendations for improved law enforcement in Chicago and in other urban centers, as a result of the Department of Justice grant.

*Now with the Joint Center for Urban Studies of Harvard and M.I.T.

Chicago's population, about 3.5 million, has been nearly constant for three years. But the constant movement of people within the city—and into and out of it—is more important. This movement affects every part of the city. Chicago is a "city of neighborhoods." Various ethnic groups have customarily stayed together. Since World War II the migration of poor, uneducated, and unskilled whites and blacks to Chicago in search of jobs has increased. These new residents find housing, and some jobs, in the older, decaying sections of the city; these areas are expanding.

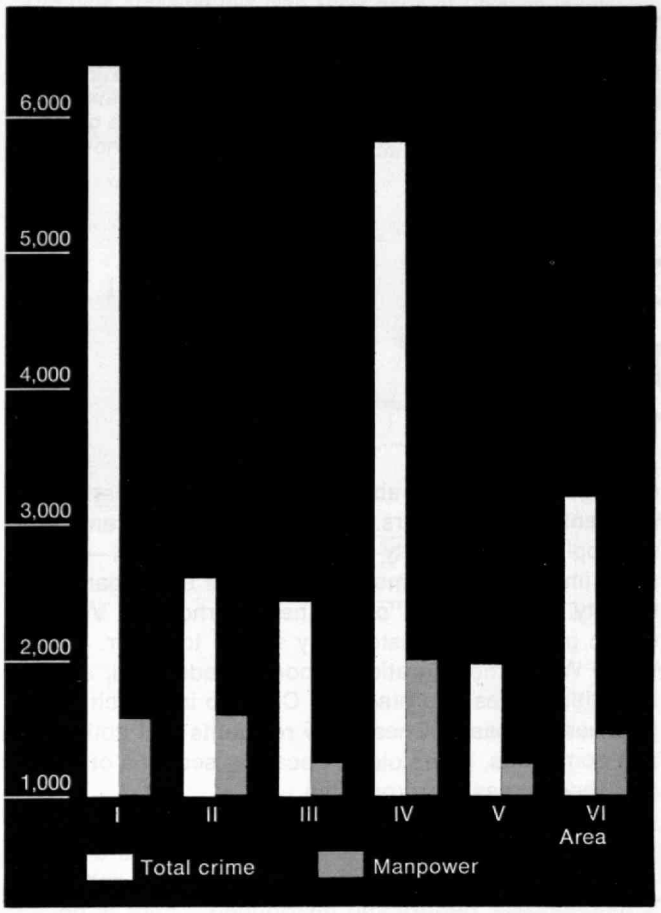
Poverty, ignorance, change, and hopelessness are among the factors that underlie serious crime and give it a recognizable geographic distribution. There is no ignoring the fact that citizens in ghetto areas are 10 to 30 times more likely to be victims of serious crime—murder, rape, robbery, serious assault, burglary, and theft (classed as serious above $50 or for auto theft). The chart shows the risk as measured in incidents per 100,000 population in the six Police Areas in Chicago. The Fifth Area is the stable residential area on the northwest side of the City. Even here the risk to the resident is about as great as it is in the average major urban area.

The deepening division between white and black America is exacerbating sensitivities and resulting in very real constraints on how police resources should be allocated and used. As a result, as the chart (see page 58) shows, the current allocation of Patrol Division manpower to the six Chicago Police Areas does not match the pattern of crime incidence. One difficulty is that the increased police activity demanded by some in the ghetto is branded by others as a manifestation of the establishment's desire to continue to subjugate and exploit minority groups.

These observations hold, to a greater or lesser extent, in each American city. The police are concerned with the immediate tasks of protecting life and property and rendering public service. Attack on the root causes of crime is largely beyond the capability and scope of the police.

The Analysis

The law enforcement system is a part of the criminal justice system, whose other components are the courts and the correctional agencies. The criminal justice



For Police Department purposes, Chicago is divided into six areas. The incidence of serious crime (the nature of this category is detailed in the text) varies widely between these areas. The manpower allotted varies far less, and without obvious correlation to the need. This chart compares the number of serious crimes per 100,000 of population (1968) with police manpower in May, 1969.

system is, in turn, part of society. In theory, the police are merely the agents for the courts, which dispense justice, and for the correction system, whereby offenders are purged of their offenses and rehabilitated. This is the theory. In 1970 in the United States of America it may not be the fact.

The relationships or lines of action and communication that exist among the police, the offender or criminal event, and the official and private groups in the city who can affect the socio-economic conditions, and thus influence crime rates, are tenuous. Their meeting point is depicted in the accompanying diagram by the "decision to execute" box in the center, which is what one would like to be able to influence.

The seven major objectives of the police can be derived from this diagram:

1. Crime control
2. Control of quasi-criminal activities
3. Public peace
4. Traffic regulation
5. Public service
6. Community support
7. Support of the Police Department

On the basis of these objectives, identified thus from a wide view of the problems, the Chicago Operations Research Task Force began its effort by making a resource-analysis budget. This allowed the Police Administrator to evaluate the allocation of financial resources against defined goals shared by the Police Department and the community.

The tools of cost-benefit analysis enabled us to transform the resource analysis budget into a program budget which could be used in a planning, programming, and budgeting system. The chart shows how available funds were divided among the major objectives for 1969. At this stage of the work it was not possible to say whether this was an efficient or proper allocation or whether a serious imbalance existed. There were no criteria.

Personnel costs account for 96 per cent of the $154 million Chicago Police Department budget. There are approximately 12,000 uniformed men, nearly three-quarters of them assigned to the Bureau of Field Services. The Patrol Division's 6,700 men are distributed among the 21 Police Districts according to a scheme that is weighted on the basis of expected workload. About 800 men are assigned to the Patrol Division Task Force, a unit that is employed primarily in high-crime areas as a preventive patrol.

The aim of the present system is to distribute the motorized beats around the city so that hazard is shared, emergencies can be met quickly, and each unit properly handles assignments given to it by the dispatcher in the communications center.

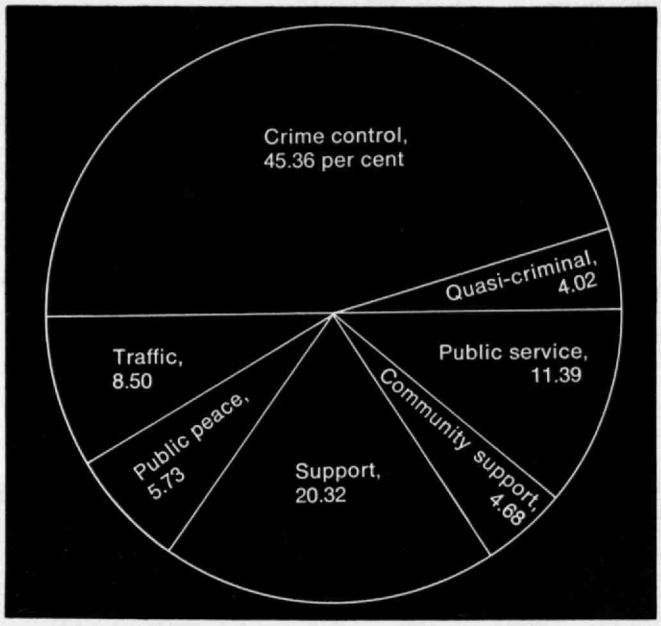
The only thing wrong with the present scheme is that it does not work. Here is the evidence.

Under the current weighting scheme, serious crime is given a weight of 4, miscellaneous criminal activity 3, and public service, as noncriminal, 1. Unfortunately, this scheme does not reflect the considerable time that a unit devotes to a call for service. That last category—noncriminal—accounts for 74 per cent of the entire 8,000 to 9,000 calls on which response units are dispatched each day. Only half of the remainder deal with serious crime.

Basically, there are two ways in which a patrol may be employed: responding to calls, and cruising with the aim of prevention. Although the city-wide average shows that the ratio between response activity and preventive patrol activity may be about 60:40, the distribution of activity is such that the units have time for little but response during the busy evening period. (A unit also loses an average of 1.9 hours per watch to such activities as lunch or car service.)

Crime control programs absorbed nearly half of the Chicago Police Department's budget in 1969. There are no criteria, says the author, to say "whether this was an efficient or proper allocation or whether a serious imbalance existed."

The police system figures prominently—but not exclusively—among the factors upon which a criminal bases his "decision to execute" a crime. How fully the diagram (below) of the law enforcement system coincides with fact and motivation in the U.S. today is an appropriate question for the reader.



It is a daily occurrence that entire districts find themselves with no units available to handle an emergency call. Units can be drawn from neighboring districts, but only with a longer response time and with a resulting severe maldistribution of resources. In spite of these difficulties, the patrols nearly manage to achieve the goal of responding within five minutes.

If the demands for service continue to increase as they have since 1964, however, saturation and overextension of the entire force lie ahead.

The quantitative methods of operations research allow us to examine resource allocation on the basis of alternative strategies. Calls for emergency service must be satisfied promptly in each Police District. On the other hand, policy on nonemergency situations or public service calls is subject to alteration by the Police Department or the City Administration. But currently the Chicago Police Department responds to all calls. This is a staggering burden.

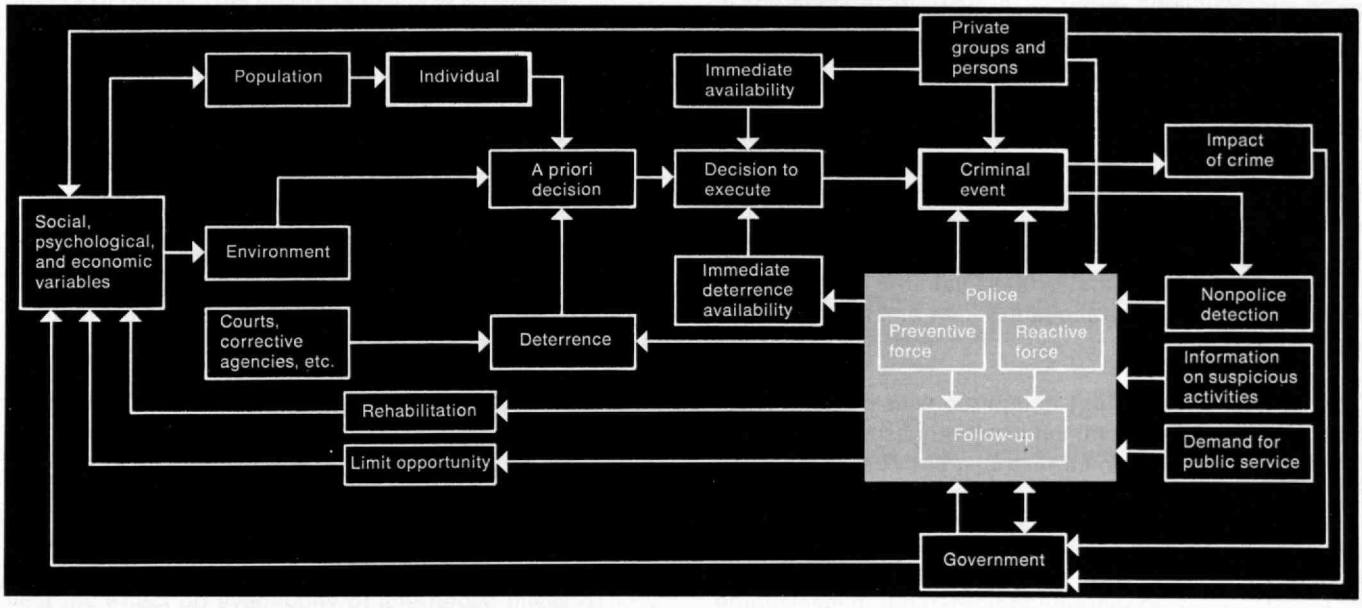
An ideal, though not yet realizable way of meeting this burden would be a dynamic technique, whereby units would be assigned to the response or preventive function as needed in each part of the city, in accordance with fluctuations in demand and with known daily variations in criminal activity. In principle this could be done continuously, but the system that could carry out such a task would have to be able to recognize individual events.

In practice it is not yet feasible to carry out the required calculation in real time, nor would frequent reallocation of manpower be feasible operationally. Nevertheless, a dynamic allocation scheme could provide a standard against which the efficiency of the actual allocations could be measured. An engineering approximation to this desired method is in fact evolving.

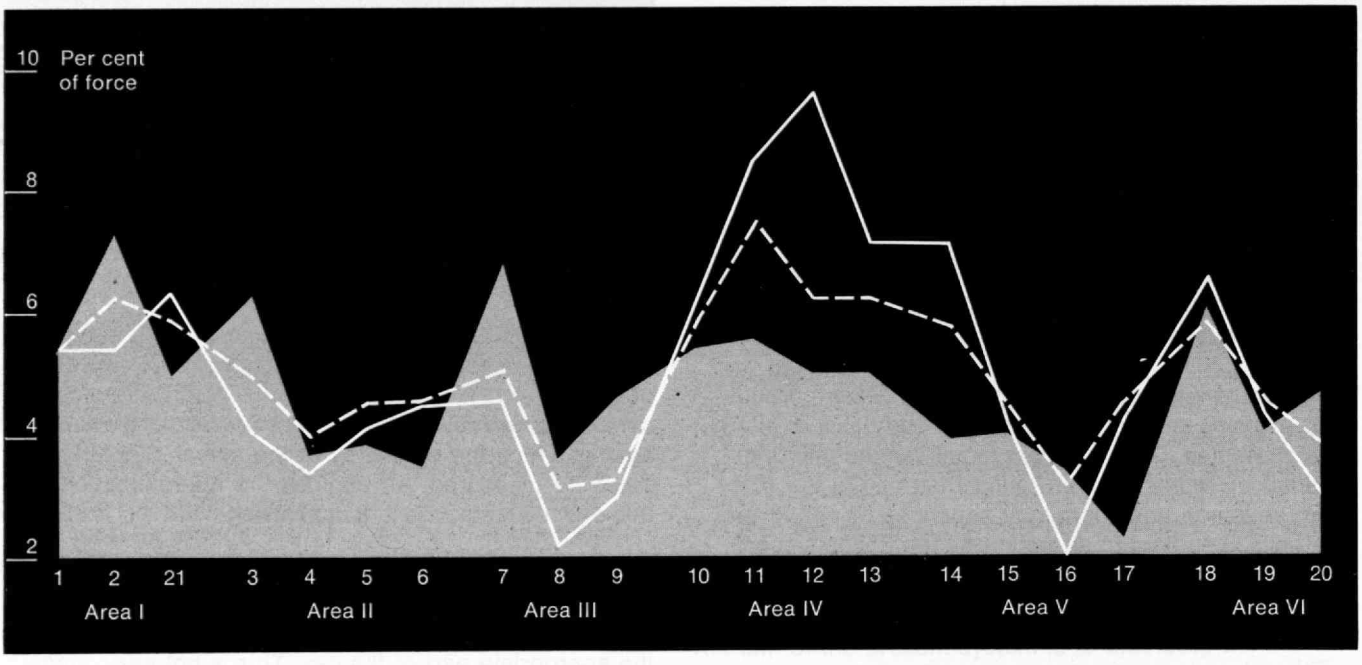
The first step is to distribute the manpower in each district so that the numerical strength of each watch corresponds to the amount of activity that occurs there during the appropriate part of the day. This is not easy, since the evening watch accounts for about half of the daily activity. It may be necessary to resort to differential pay.

Allocating the Patrols

The first question, in designing a patrol force, is how to



How shall the members of a police force be assigned among the various districts of a city with their different problems and demands? This chart shows an effort to analyze this question for six areas (21 districts) of the City of Chicago, based on the differing crime rates in each. The solid line shows the assignments resulting under the assumption that police are equally effective in all districts; the dashed line on the basis of equalizing the ratio of felonies to manpower. The gray area shows the allocations of policemen as of May, 1969.



distribute it so as to have maximum impact on crime while providing high-quality police assistance to the public. The Operations Research Task Force took into account the local levels of criminal activity—higher in economically disadvantaged sections of the city—weighted according to public feelings about each type of major crime (established by opinion surveys); and considered also the population of each district and the effectiveness of police activity.

On the assumption—not ungrounded—that criminal activity is inversely proportional to police manpower assigned in any district, these factors are combined for each district into a crime-to-manpower function. By minimizing the sum of crime-to-manpower ratios (subject to the constraint of the total size of the force), we arrive at a rule for allocating men among the competing districts.

The accompanying chart compares with present practice the allocations obtained if (a) we assume that police are equally effective in all districts, and (b) we measure police effectiveness in terms of the ratio of felony arrests to police manpower assigned. The reason all allocations to the First District are identical is that the First District is the Chicago Loop, whose population varies by about 1,000,000 persons between day and night, so that the allocation formula cannot be used. Consequently the allocation to the First District was kept constant (374 men).

The importance of this approach to overall allocation of police resources is that it attempts to reconcile societal values, operational considerations, and economic reality within the framework of a stated objective—minimization of criminal activity. Lack of time prevented us from extending the method to include other measures of efficiency of police allocation. But another approach is suggested in the study of preventive patrol, which I shall come to later in this article.

Increasing the Efficiency of Response

The force assigned to the streets is thought of as being divided into two parts—for response and for prevention (the "split-force" concept).

The number of units required for *response,* at each hour of the day and in each district, is estimated straightforwardly by applying theory to a mathematical forecast on demand. The chart on the next page relates the number of units required to the frequency of calls for service; the average time required to satisfy a demand varies in different districts, and this too affects the number of cars needed, as shown.

Demands for service are predictable with considerable accuracy. For demonstration purposes a simple linear prediction from the previous year on the basis of the observed upward trend has been found to be accurate to 5 per cent.

The key to an effective response force is "unit availability"—the probability that a unit will be able to accept an assignment. A probability between 0.5 and 0.6 would justify a high degree of confidence that prompt emergency response is possible. In the summer of 1969, in Chicago, availability was less than 0.3 during peak periods.

Virtually all of our analytical work and field experimentation on response had the objective of increasing availability. One way to do this might be to reduce the number of demands for service. This can be accomplished administratively by a change in the policy regarding dispatch of response units to nonemergency, nonpolice calls. Detroit and St. Louis have instituted a screening procedure that yields nearly a 30 per cent reduction in the number of calls to which units are dispatched.

The final chart shows the potential increase in preventive patrol time if a 30 per cent reduction in calls for service can be effected. (Also shown is the effect of the constant load of administrative activity. Unfortunately, much of this activity is essential to the well-being of the police officers and is not easily curtailed.)

Toward Better Preventive Patrolling

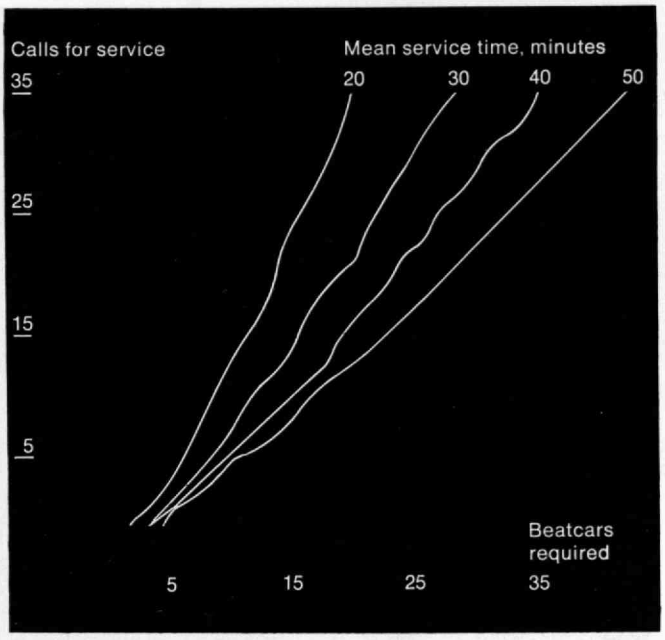
Examination has revealed that the burden of responding to calls for service, plus the inevitable down-time of cars for administrative measures, has resulted in severe erosion of the time available for *preventive* patrolling—which is our principal opportunity for taking initiative in the fight against crime.

One would like—ideally—to be on the spot when a crime is being attempted. There are several alternative approaches to accomplishing this objective. The study of these alternatives will result, eventually, in a unified theory of patrol. This theory is just now emerging.

An important finding is that the high-volume crimes—robbery, burglary, and auto theft—tend to cluster in specific locations. It has been found possible, by marrying some "search-theory" ideas developed originally by B. O. Koopman to some new capabilities in computer graphics, to work out priorities for the assignment of preventive patrol units. This method has been tested for a short time in Chicago's Second District for the special case of robbery prevention. Further work of this kind has so far been limited by the amount of computer time available.

Study of the preventive operations of patrols had at least one other major result. The necessity for preventive patrols to carry out a number of responsive activities, ranging from traffic stops to "stop and frisk," severely reduces their availability as the watch wears on. Through computer simulation it has been possible to test the effect on availability of alternative mission-assignment policies; and a 10- to 30-fold improvement in the probability of "being on the spot" turns out to be possible with current resources.

How many police cars must be assigned to a district to limit the average wait for an available car to 6 seconds? This chart provides the answer—subject only to variations in the efficiency such as the time required by a car to handle a call and traffic conditions.



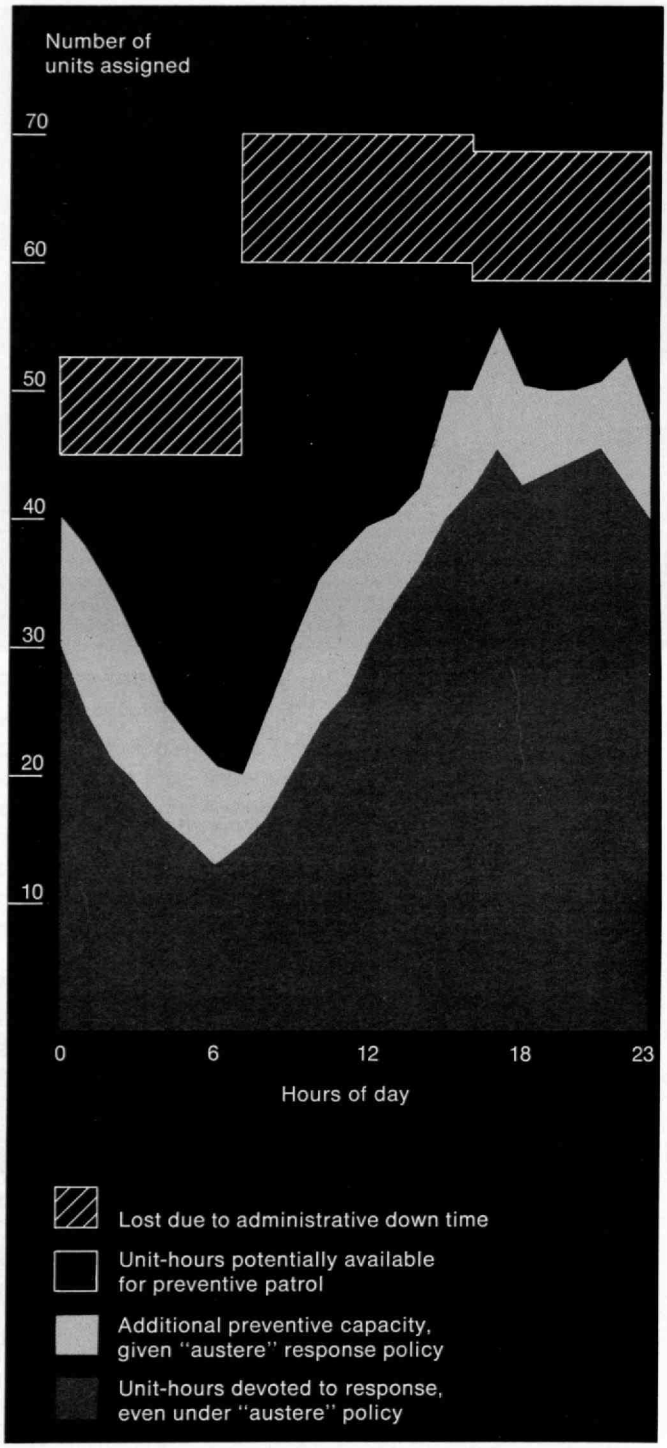
A Practical Trial

All of the above-mentioned work was drawn together in the summer of 1969 in a crucial administrative experiment carried out in the Fourteenth District. The split-force concept was applied, and the forecasting-and-queuing approach was used to decide the "response" force sent out at each hour of the day.

Resources left over were called "strategic" patrols and were given mission assignments. It turned out to be difficult to design mission assignments that would observably increase effectiveness, as measured by felony arrests. This fact reaffirms the importance of developing a theory of preventive patrol.

The participating police were enthusiastic about the experiment, since they welcomed the opportunity to exercise initiative. No degradation in response time or level of police service occurred during the experiment. The key measures observed were felony arrests, response time, effort devoted to strategic patrol, instances when the district had no response units, and morale and enthusiasm of the participating officers.

One way to give patrolmen more time for crime prevention is to reduce the competing demands on their time—from nonemergency, nonpolice calls, for example. If under an austerity policy the number of response units (see page 61) can be reduced by 30 per cent, a large additional amount of time (light grey area) can be devoted to preventive patrol instead of to response. Such austerity is now in effect in some major American cities.



As a result of this experiment, the Task Force has learned enough to be able to implement the new approach throughout the city, while bearing in mind the particular situation of each district.

There is little doubt that the potential of the computer as a management tool in law enforcement has scarcely been tapped. The various analytical methods and computer-simulation models that result from the work of the Operations Research Task Force can be seen as elements of an eventual police management information system.

What is needed is a study that will reveal the kinds of information that are most desirable for making operational and management decisions in this field. This is one area where the dialogue between the scientific community and the operational community of law enforcement can yield huge dividends in improving the basis on which decisions are made.

The principal conclusion of this demonstration project is that resource allocation problems of law enforcement agencies are in fact amenable to the operations research/system analysis methods. Units similar to the Operations Research Task Force of the Chicago Police Department should be established and actively supported within every major law enforcement agency.

Suggested Readings

The Challenge of Crime in a Free Society, the Report of the President's Commission on the Administration of Criminal Justice.

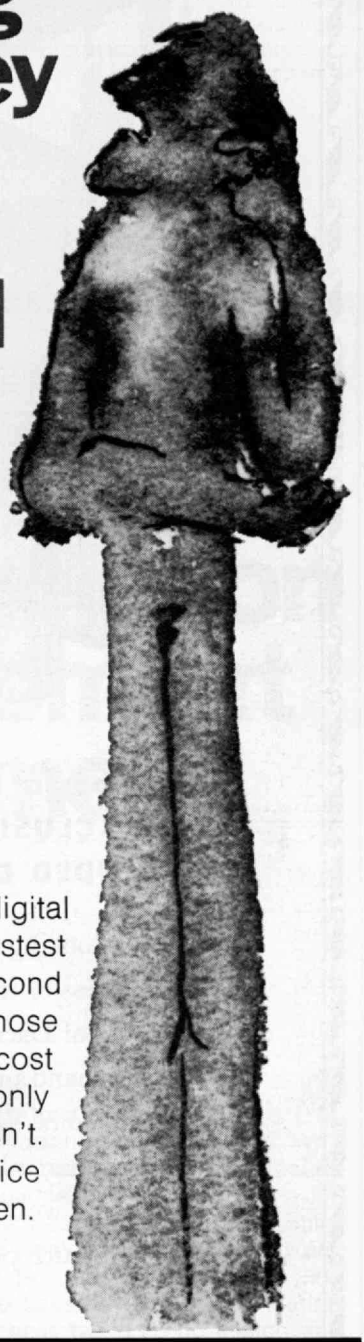
Science and Technology in Law Enforcement, A Task Force Report to the President's Crime Commission.

Proceedings of the First and Second National Symposia on the Application of Science and Technology to Law Enforcement, Illinois Institute of Technology Research Institute. (Proceedings of the Third Symposium, April, 1970, will be available in the near future.)

Allocation of Resources in the Chicago Police Department, Final Report of the Chicago Police Department Operations Research Task Force, Law Enforcement Assistance Administration, U.S. Department of Justice.

Albert M. Bottoms studied for a master's degree in oceanography at M.I.T. He has specialized in military operations research and served with the Institute for Defense Analyses in Washington and with the Navy Department before joining the Operations Research Task Force of the Chicago Police Department as its Director. He is now a Research Associate at the Joint Center for Urban Studies of Harvard and M.I.T. and President of Fundamental Systems, Inc., a consulting firm having principal activities in Chicago, Boston, and Washington, D.C. Ernst K. Nilsson received his B.A. in economics at Northwestern, his M.B.A. from the University of Chicago, and his Ph.D. from Northwestern. David G. Olson is currently a Ph.D. candidate at Northwestern University. He received a B.S. in engineering physics from Purdue, an S.M. in oceanography from M.I.T., and was with the U.S. Naval Electronics Laboratory prior to joining the Chicago Police Department.

Instead of spending an awful lot of money (groan) on big computers to do signal processing, why not just buy the CSP-30 for the price of one month's rental? (Yeah, why not!)



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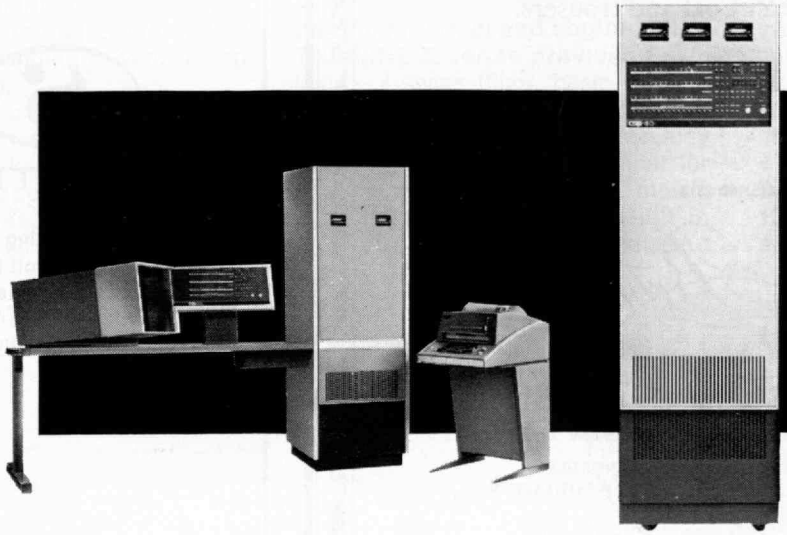

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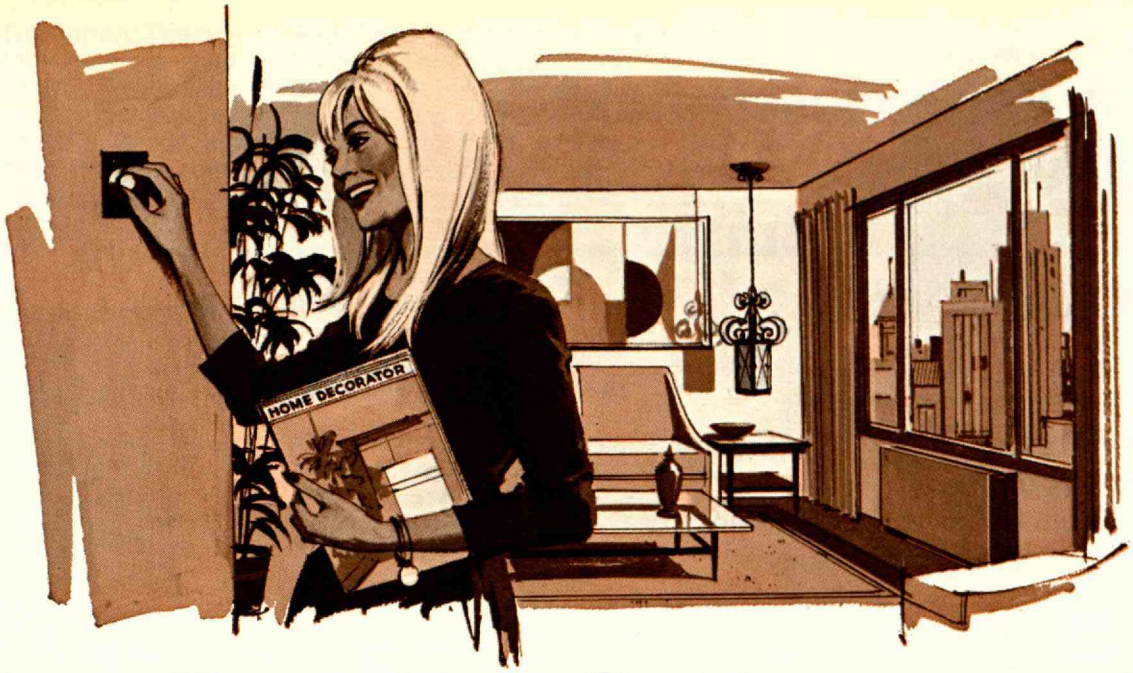

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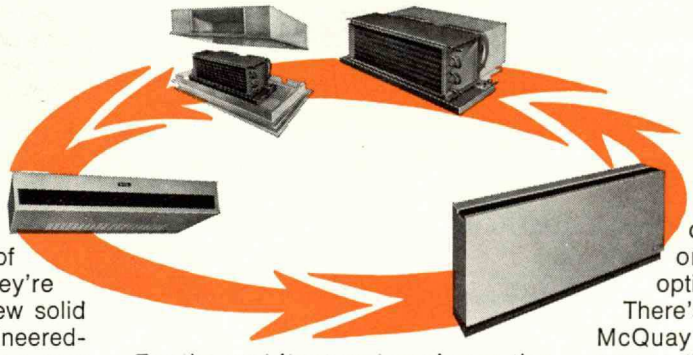

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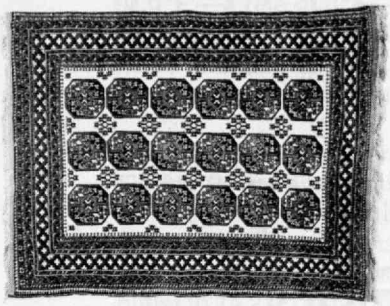

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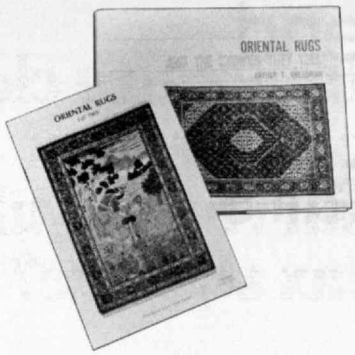

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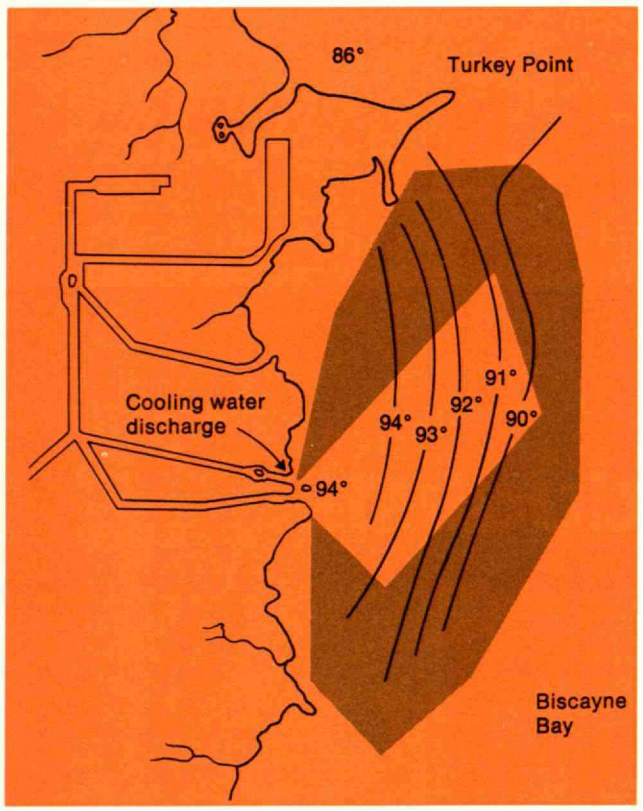


The water-temperature curves show the mean of the daily maxima around the Turkey Point outlet, August, 1969. The tinted region is the zone of biological damage attributed to heat-pollution in that year. The black region within it is that of "acute" biological effects observed June 25 of the same year.

The Power versus the Glory

In April, 1968, the Florida Power and Light Company's new Turkey Point station, about midway along the shore of Biscayne Bay, reached a capacity of 720 MW. (normal load). In October of the same year, Congress authorized $27,500,000 for the establishment of the Biscayne National Monument, to "preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibian life in a geographical setting of great natural beauty"—a setting that these life forms shared, however, with the Turkey Point power plant, which takes in 820 million gallons of water from the bay each day, and returns it, anything up to 14°F. warmer, through a number of canals (the most notable of which is called Grand Canal).

In the following month, "an underwater search of an area 500 yards offshore from the mouth of Grand Canal showed that few living plants remained and that none of the usual invertebrate animals populating 'grass bed' environments remained. A zone of nearly complete destruction of the plant and animal life extended from the mouth of Grand Canal into the bay for 500 to 700 yards," according to a team from the Federal Water Pollution Control Administration, who presented results of their studies of thermal pollution in Biscayne Bay at a meeting of the Institute of Environmental Sciences held in Boston this April.

The team's speaker, Thomas P. Gallagher, Chief of Engineering Services in the F.W.P.C.A.'s Southeast Region, went on to describe observations in June, 1969:

". . . A grid pattern of study sites located at 500-yard intervals was established. A thorough underwater examination at these sites revealed severe damage to benthic plant and animal populations, including corals, sponges, sessile green algae, crustacea and molluscs in an area extending 1,000 yards east, 1,000 or more yards north and 500 or more yards south from the mouth of Grand Canal. An area evidencing a moderate degree of damage to benthic inhabitants extended east-north-east from the mouth of Grand Canal to a point 1,500 yards into Biscayne Bay. . . . The total estimated area of

damage in Biscayne Bay, occurring during the summer months of 1969, based solely on the lethal effect of overheating, amounted to about 670 acres of bay bottom."

In parallel with the biological observations, the team had observed temperatures. At the power station intake, in August, 1969, the mean daily water temperature maximum was 86.0°F.; for the month, the maximum was 88.0°F. At the outlet, the mean daily maximum was 94.0°F.—a rise of 8°F.—and "temperatures as high as 95°F. occurred up to 1,000 yards east and 1,500 yards north of Grand Canal." Isotherms of mean daily maximum are shown in the map.

Scheduled for operation beginning in 1971 and 1972, Florida Power and Light has two nuclear units at the same site, with a combined normal full load of 1,360 MW(e), bringing the total water requirement to 2.75 billion gallons per day, and the temperature rise at the outlet to 14.2°F. at full load.

In March this year, a suit was filed against Florida Power and Light at the request of Secretary of the Interior Walter J. Hickel, with the object of halting thermal pollution of the bay by the company. The suit was filed under an 1899 statute concerning refuse. The case is complicated by the fact that heat itself can apparently not be treated as refuse, and the complaint against the company refers to "micro and other small organisms" which are killed on their passage through the station's heat exchangers and emerge as refuse. In his report, however, Gallagher made it clear that what was to blame was the elevated temperature of the bay water, and not any material pollutant.

Man, Not Technology

Following its long-term study of how to understand what man's technology is doing to the earth and its inhabitants (*see* Technology Review *for January, 1970, pp. 58-59*), Representative Emilio Q. Daddario's Subcommittee on Science, Research and Development has given Congress a plan for a new tool to help it make decisions about the future.

The Office of Technology Assessment would be the first new congressional arm to evolve since the General Accounting Office was formed in 1921. Its duties would be simply to help Congress identify impacts of technology, to establish cause-and-effect relationships between technological developments and their consequences, to suggest alternatives, and to identify research needs.

Speaking to the annual convention of the Institute of Electrical and Electronics Engineers in New York this spring, where he unveiled the plan for the O.T.A., Mr. Daddario was at pains to make two things clear: the O.T.A. will not become another large research enterprise; it will simply identify problems and look for the means to understand them better. And the O.T.A. is not an attack on technology: "It is time we stopped treating technology as though it were a time bomb which we must defuse," he told the I.E.E.E. "The tribulations which have come to us through technology in recent years stem not from the nature of technology but from the nature of man."

National Laboratories: R&D for the Whole

Can America's existing large, federal laboratories be converted into National Environmental Laboratories whose field of action would be "the whole environment, both urban and rural, both present and future?"

The original proposers of this form of conversion—a group of scientists at the Oak Ridge National Laboratory led by David J. Rose, M.I.T. Professor of Nuclear Engineering who is on leave at O.R.N.L. this year—have now received the most encouraging form of encouragement: $4 million has been put into the National Science Foundation's budget proposal by the House Subcommittee on Science, Research and Development to fund pilot studies of the knowledge which will be needed by the Congressional Office of Technology Assessment (*see above*).

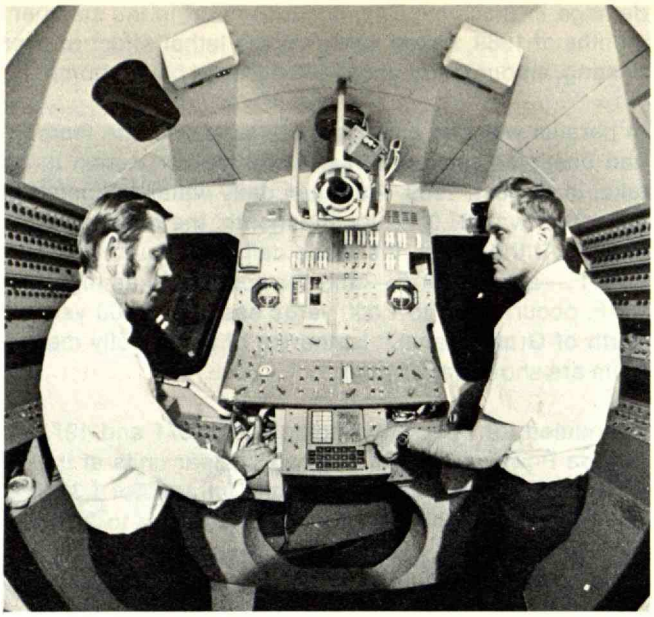
Professor Rose and his colleagues would give the National Environmental Laboratories a two-fold assignment:

1. Develop and present to policy-makers "ordered sets of alternatives, with relative costs and benefits clearly defined, . . . (on) problems affecting the existing or future environment;" and
2. Make sure that "all sectors in the nation" understand the available options.

But, says the committee proposal, the laboratories would have "no decision-making or regulatory functions." In other words, these National Environmental Laboratories might become the "research and development for the whole" laboratories, in a sense analogous to the role of similar units at the top levels of the best managed industrial corporations.

The basic problem to which its proposal is addressed, says the O.R.N.L. group which reports as the *"ad hoc* N.E.L. Concept Committee," is that the issues now be-

Lunar Module simulator at the Draper Laboratory, seen through a fish-eye lens, gives some idea of the quarters to which the Apollo 13 crew retreated—and from which they piloted their three-module ship—during their return to earth from lunar orbit. On the right is David Hoag, director of the Laboratory's Apollo group; on the left, Russell Larson, who directed the programming of the Lunar Module's guidance computer for this mission.



fore the nation—and their intertwined causes and effects—are so large and involve so many different elements of daily life that present institutions simply cannot deal with them effectively. As a result, says the group's preliminary report, "no optimal overall solution can be found even in principle through any process of optimizing each part separately. Since future paths cannot be seen clearly," the committee writes, "breadth must replace acuity of vision."

One example of an issue upon which the proposed National Environmental Laboratories could work is explored by the committee in its first report: power for the future. At least three interacting factors which must affect policy decisions are listed:

1. The internal technology of power generation itself—nuclear reactors, fossil fuels, hydro, and perhaps others—and the technology of power transmission.

2. The demographic effects of (a) different power costs under different economic and social conditions; (b) cheap process heat; (c) the concentration or spreading out of power sources with variation in size; and (d) urban and rural planning.

3. Siting policy for new installations, per se: (a) the internal cost of nonelectric products including heat; and (b) off-plant environmental factors including alternate land use, pollution, political attitudes, and esthetic costs. Other examples of problems "that now do not seem to fit present organizations" include these: environmental indices to quantify the state of the environment in useful ways; assessing the hazards of specific chemical and physical agents in the environment; waste management and the recycling of materials.

Simplify the problem this way, says the committee: Conservationists tend to suppress technology, while the industrial economy tends to promote it. "To achieve the balance," says the report, "we join these concepts in one organization, hoping to produce a most reasonable view."

"Are we preaching a counsel of unattainable perfection? Not this side of Paradise. . . . It is the making things better than hitherto that we try to bring about; for this, no one expects us to do more than our best—or less."

The What-If's of Apollo 13

On Monday, April 13, the configuration of the Apollo 13 system was conventional enough: in the middle, the conical Command Module, designed to carry three men to the vicinity of the moon; behind it, the Service Module, containing fuel tanks and fuel cells; and in front, mounted on the nose of the Command Module, the Lunar Module, designed to land two men on the surface. When the Service Module's oxygen tank exploded, the abrupt loss of oxygen and power caused some unconventional techniques to be adopted.

In spite of everything, the return trip was very like the usual story. Soon after the explosion, when the Lunar Module's guidance system was started up and oriented by reference to the Command system (which was then shut down), a brief burn raised the orbit well clear of the moon's surface. Another burn, on April 14, and a midcourse correction the following day, brought the ship (which would normally have left the Lunar Module behind) into an accurate earthward path. After a final firing to adjust the angle at which the path would enter the atmosphere, the Service and Lunar modules were abandoned, and the crew came down within half a mile of the South Pacific target.

That these switches and maneuvers were a complete success, and worked as predicted, owed much to the advice that Mission Control received from, among other places, M.I.T.'s Draper Laboratory. Most of the inertial guidance system for Apollo was the product of the Draper Laboratory, and during Apollo flights the Laboratory has a monitoring and consultation role. Accordingly there is at the Laboratory an ongoing program of investigations of what are called "what-ifs."

What if the Lunar Module has to be used to drive, steer, and orientate an assembly consisting of all three modules, with the Service Module—at the top—lopsided

from an explosion? This is what actually happened, and in fact parts of such a contingency had already been simulated at the Draper Laboratory. But it was largely a new "what-if."

For one thing, many of the Lunar Module's systems were shut down to save power. The inertial guidance system designed at Draper—of which Apollo possessed three, one in each module—was not used; instead, for the sake of a saving in water cooling, a simpler Grumman system was employed, whose normal role is confined to navigation in the region of the moon. For observing the attitude of the ship, the pilots did not have the use of the visual-analogue "eight-ball," but had to read numerical displays generated by a computer. In maneuvering to the attitude required before a burn, the three attitude dimensions were shared out between two pilots. Each burn was of course simulated beforehand on earth, as were the measures that would have to be taken if the unwieldy structure had misbehaved and the burn had been perforce interrupted.

But, thanks to Apollo's many backup systems and in-built alternative uses, everything worked as the crew were told it would—even down to the start-up behavior of the Command Module's guidance system when it was finally brought back into action for the re-entry after four days in the cold.

The Draper Laboratory had been asked about the effects of cold on the guidance unit, and about procedures for re-starting. After a great deal of careful consideration, and some practical testing of a duplicate unit, the Laboratory came up with a minute-by-minute account of how the system would behave at different temperatures and voltages which proved to be correct. In fact, the Laboratory team's initial consensus on the re-start question, arrived at about 100 hours ahead of time, proved to have been accurate enough.

Science in Disarray

Citing "a series of federal actions," James R. Killian, Jr., Chairman of the M.I.T. Corporation, told a special subcommittee of the U.S. Senate this spring that curtailed support for basic research and scientific and engineering education now threatens to reduce enrollments in science and engineering schools, to break up experienced teams, to close facilities, and "to erode the preeminent position of the U.S. in science and technology."

In 30 years of college administrative work, said Dr. Killian, "I recall no time when the financial outlook was so bleak. We fear an unprecedented financial crunch."

As causes, Dr. Killian cited the so-called Mansfield Amendment to the Military Procurement Authorization Act for 1970, which permits military support only for mission-oriented research; the reduction of graduate fellowship support under the National Defense Education Act and National Institutes of Health programs; the gradual ending of the traineeship and sustaining university programs of the National Aeronautics and Space Administration; expenditure ceilings, grant reductions, and statutory limitations on indirect costs applying to the National Science Foundation and National Institutes of Health; and curtailment of undergraduate support under the National Defense Student Loan Fund.

Though he recognizes the need for belt tightening and improving research management, Dr. Killian told the Senate committee, "I submit that an accumulation of uncoordinated actions have brought disorder to the house of science." Having reached this stage of disarray, can science and government—working together—restore understanding and forward movement to what Dr. Killian called "the carefully nurtured partnership of the federal government and our universities which has been so spectacularly successful over 30 years"?

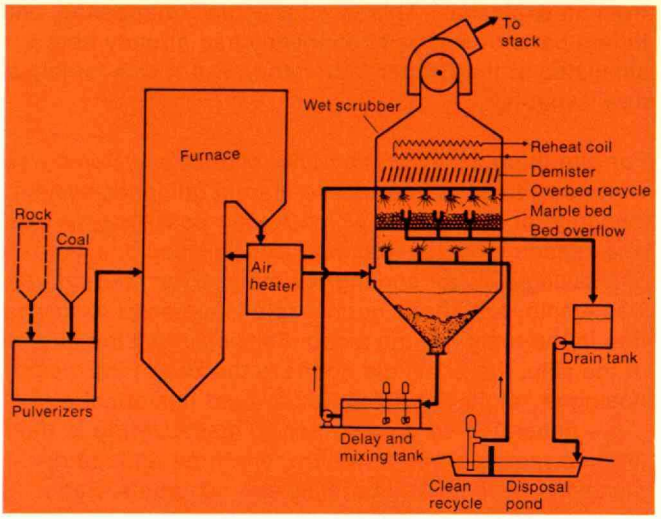
The answer rests largely with the National Science Foundation, said Dr. Killian. It must have funds at once to maintain the ongoing activities now denied by the Mansfield Amendment to the military agencies. It must continue its traineeship program and if possible expand it to compensate for cuts in similar programs in other agencies. It must be freed from restrictions which require N.S.F.-university agreements to be on a cost-sharing basis.

(A similar proposal for increasing N.S.F.'s leverage came from Senator Edward M. Kennedy, speaking at M.I.T. on April 3; he then announced his proposal for a $50 million (10 per cent) increase in N.S.F.'s fiscal 1971 budget—a plan which, he said "will enable the Foundation to support worthwhile projects dropped by the mission-oriented agencies" and more socially oriented programs as well. *Science* magazine speculated that the action announced in the M.I.T. address might symbolize Senator Kennedy's "emergence as the leading congressional advocate of scientific research," a role in which he would succeed retiring Congressman Emilio Q. Daddario.)

Finally, said Dr. Killian, Congress should look again at the Mansfield Amendment. "I feel strongly," he said, "that in the long run it would be damaging to the mission-oriented agencies to isolate them from basic research and to deny them these kinds of relationships with the research community."

Indeed, said Dr. Killian, citing these agencies' "percep-

System for removal of sulfur oxides and particles from the stack effluent of Kansas Power and Light's Lawrence Unit No. 4. The system was devised by Combustion Engineering, Inc., and modified by the two companies working together on the difficulties that arose in full-scale practice.



tive" support in the past, "I feel it of vital importance to maintain national policies which call upon the mission-oriented agencies to fund their proportional part of the nation's basic research."

The Hard Road to Low Sulfur Emissions

Elusive sulfur oxides are being trapped and flushed away on a regular working basis at the Kansas Power and Light Company's Lawrence Station, using a lime-injection/wet-scrubber system devised by Combustion Engineering, Inc. The Kansas company is thought to be the first in world with this method in everyday operation. But because the system was taken straight to the 125-MW. station from C.E.'s laboratory test rig, the road to efficiency was not an easy one, and involved numerous and frustrating modifications.

Kelly Green, K.P.L. production engineer, explained: "There are no two power plants, no two plant boilers and for that matter, no two coal seams on the face of the earth that are exactly the same."

Green and Lee Brunton, Lawrence plant superintendent, however, acknowledge that the basic principle of the system was and is valid. And the National Air Pollution Control administration regards the wet-scrubber system as "the first likely to succeed of the near-future processes—with the greatest immediate potential for SO_2 control," according to R. E Harrington, chief of development of the engineering branch, N.A.P.C.A. division of process control engineering, Cincinnati, O.

The C.E. principle for controlling sulfur oxide emissions (80 per cent of which come from coal- and oil-burning power plants) is to convert the evasive gases into more easily trapped solids—calcium sulfate or calcium sulfite. First, 20 to 30 per cent of the sulfur dioxide released within the boiler is combined with pulverized rock (lime) in a dry reaction. The flue gas stream leaving the boiler thus consists of fly ash, trapped SO_2 and untrapped SO_2. On entering the wet-scrubber—a perforated stainless-steel plate supporting a 4½-inch layer of pyrex marbles, violently agitated by jets of water—the remaining sulfur oxides combine with remaining lime in a wet reaction.

At the Lawrence plant, the scrubber effluent is then removed to a drainage tank whence it flows to a 16-acre clarification pond. After clarification the water is recycled to minimize use of the local water supply.

Mechanical problems were encountered in several stages of the system within a few days after installation.

◇ In the boiler, the lime particles were being "overburned," reducing their reactivity with the SO_2.
◇ In the duct-work, heavy build-up of moist ash cement was encountered, reducing efficiency and, of course, clogging the inlet to the scrubber.
◇ In the scrubber, heavier pollutant particles tended to drop out of the flue stream in the inlet plenum before reaching the fluidized bed.

The two companies' engineers solved these problems by trial and error, achieving the present consistent operating efficiency of 99 percent fly ash removal and 83 percent SO_2 removal.

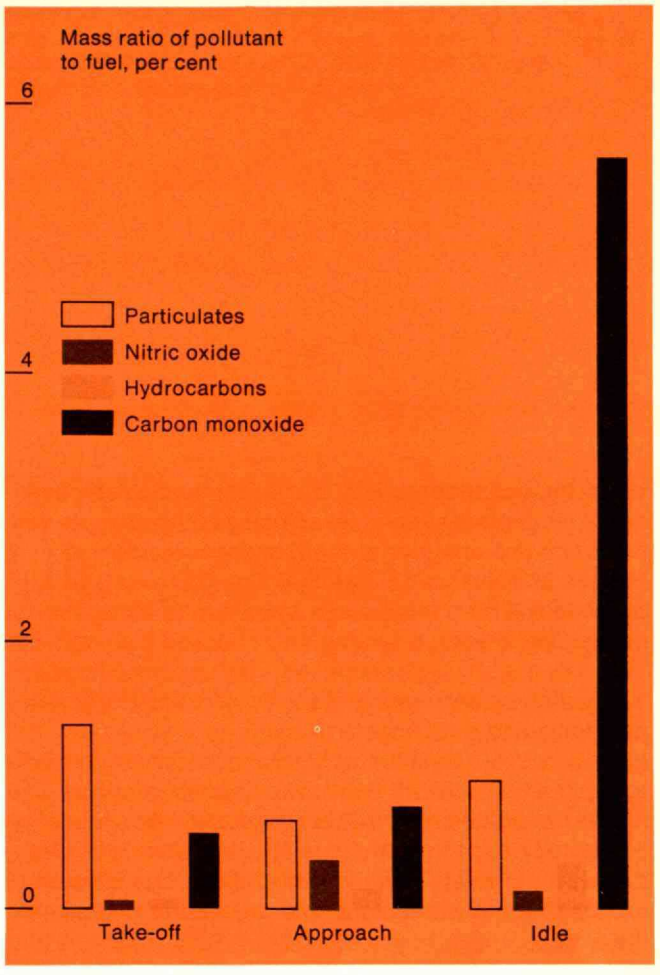
The original design called for pulverizing the fuel and rock and blowing them into the boiler together. The overburning problem was solved by, instead, separately pulverizing the lime and injecting it into the boiler above the actual fuel flame where temperature would peak at no more than 2,200°F.

The heavy build-up of ash cement around the edges of the dry-wet interface at the scrubber inlet duct was due to eddies in the gas flue stream which were drawing moist air back into the duct: the solution was basically aerodynamic.

To recover the drop-out pollutants, a detention tank was installed to catch the heavy solids and some of the bed overflow water, and then recycle them through the fluidized bed from the top.

The coal regularly being fired at the Lawrence station is 3.4 per cent sulfur, 12.5 per cent ash. Company officials are pleased enough with the results of their system to move ahead with the construction of six wet-scrubber units to service a 430-MW. unit that will go into operation in 1971.—*Rosalind Ellingsworth*

An idling jet engine typically produces more than nine times as much carbon monoxide per pound of fuel consumed as a jet engine operating at full power, as on take-off. But the particulate matter—mostly carbon—produced by jets under all operating conditions is the most persistent pollutant, remaining above the levels of typical urban environments in the aircraft's wake for at least 2.5 minutes after its passage, according to three members of the M.I.T. Department of Mechanical Engineering.



Necessary and Timely

The exhaust plumes from the engines of an ascending jet aircraft contain four pollutants: carbon particles (i.e., smoke), nitric oxide, unburned hydrocarbons, and carbon monoxide. Typically these pollutants add up to 1 per cent by weight of the fuel being consumed. While the emission of solid carbon and nitric oxide is heaviest while the aircraft is flying, unburned hydrocarbons and carbon monoxide are most important when the aircraft's engines are idling.

John B. Heywood, James A. Fay, and Lawrence H. Linden, of the M.I.T. Department of Mechanical Engineering, presented these conclusions from a study of the emission levels of pollutants from jet engines, the physical processes controlling their production, and their dispersion in the atmosphere late this winter at the Annual Aerospace Sciences Meeting of the American Institute of Aeronautics and Astronautics.

Knowledge of combustion processes and temperature distributions in aircraft gas turbine engines is presently insufficient for a full understanding of how these pollutants are formed and can be controlled. Carbon emission can presumably be reduced by designs which assure better mixing of fuel and air, which would lower the amount of solid carbon formed. A possible alternative is to increase the residence times of the carbon particles in the high-temperature regions of the combustor. "To reach the exhaust without being consumed," say the M.I.T. investigators, "a soot particle may have to spend most of its time travelling in the relatively cooler areas of the combustor."

Dispersion of the jet engine pollutants is equally hard to estimate, since it depends upon local meteorological conditions and the interaction of the aircraft wake with the engine exhaust plume, as well as emission levels. But preliminary calculations reported by the M.I.T. group suggest that only when the jet trail has diffused enough to occupy a circle 400 ft. in diameter are nitric oxide and carbon particulate concentrations reduced to what may be described as values "typical of present urban environments." Similarly, carbon monoxide is reduced to 5 p.p.m. when the trail achieves an area of 60 sq. ft.; hydrocarbons disperse to 2 p.p.m. C at 250 sq. ft.; a concentration of 10 micrograms/cu.m. of particulates remains until the cross-sectional area of the jet trail reaches at least 150,000 sq. ft.—a size achieved in something over 2.5 minutes after passage of the aircraft. Presumably this confirms what housewives who live near airport runways need not be told: their curtains need washing more often.

The engineers stress that their results "should be regarded as preliminary, since several areas require further study." However, they continue, "Since emission of pollutants by aircraft is a cause for public concern, further work in these areas is both necessary and timely."

Man and Pollution vs. Air and Water

A major study analyzing scientific, technological, economic, social, and policy aspects of pollution in the atmosphere-ocean system will be conducted under M.I.T. auspices during the summer of 1970. The Steering Committee chaired by Carroll L. Wilson, Professor of Management at M.I.T., has drawn together for the study more than 50 experts from some 17 academic institutions, 11 federal agencies and departments, 3 national laboratories, and 12 industrial and nonprofit corporations and institutions.

For the entire month of July, meteorologists, physical

chemists, oceanographers, biologists, ecologists, engineers, economists, political scientists, and lawyers will work and live together at the Greylock Residential Houses at Williams College in Williamstown, Mass. Their purpose will be a three-stage approach to atmospheric-oceanic pollution:

1. To analyze and synthesize present knowledge of pollutants and their effects.
2. To prepare a detailed outline of new research, monitoring, and other work needed to determine critical unknowns about long-term effects and controls.
3. To study economic and social costs of various alternatives to alleviate pollution, identifying agencies and groups that are available and/or needed to implement the work.

Professor Wilson points out that—despite broad interest in ecological problems exemplified by many research activities—"no sustained effort is being made to bring specialists together to look at the long-term global effects of pollution in a systematic manner." Hence, he believes, the potential contribution of "this broad systems view of the global environment . . . to future research and to enlightened policy making could be very significant."

The Steering Committee proposes that long-term effects on climate and on oceans—and thus on man and all terrestrial life—be studied by the experts for each of a wide range of pollutants: carbon dioxide, particulate matter, and such other combustion products as nitric oxides, hydrocarbons, lead compounds, and sulfur dioxide; water vapor; heat, inorganic and synthetic organic compounds; and compounds containing phosphorus, nitrogen, and potassium.

In anticipation of the 1970 summer study, a task force of industrial, federal, and university representatives directed by Raymond F. Baddour, Adel F. Sarofim, and Geoffrey Margolis, all members of the M.I.T. faculty in the Department of Chemical Engineering, is currently developing an overview of the amounts, rates, routes, and reservoirs of the major inorganic and synthetic organic materials released to the environment by U.S. productive mechanisms. Professor Wilson believes that this body of data—also essentially unique because of its depth and breadth—will be an important contribution to the summer study.

The summer study will lead to several stages of general and detailed reports, and Professor Wilson hopes that it will serve as a pilot model for a similar international study planned during the summer in 1971—which, in turn, will prepare delegates to the United Nations Conference on the Human Environment set for the summer of 1972 in Stockholm.

Grants from eight federal departments and agencies, including the National Science Foundation, and four private foundations—in all, a total of over $250,000—make possible the 1970 summer study. Its Steering Committee includes, in addition to Professors Wilson and Baddour, Raymond L. Bisplinghoff, Dean of the M.I.T. School of Engineering; John L. Buckley, Chairman of the Committee on Environmental Quality of the Federal Council for Science and Technology; Richard A. Carpenter, Chief of the Environmental Policy Division of the Legislative Reference Service; Paul M. Fye, Director of the Woods Hole Oceanographic Institution; Thomas F. Malone, Vice-President of the University of Connecticut; William H. Mathews, M.I.T. graduate student in political science; Richard S. Morse, Lecturer in the Sloan School of Management, M.I.T.; George W. Rathjens, Professor of Political Science, M.I.T.; and Roger Revelle, Director of the Center for Population Studies, Harvard University.

An Undersea Desert

When the oil barge *Florida* came ashore off Falmouth, Mass., last September 16, she delivered some 70,000 gallons of No. 2 fuel oil almost to the doorstep of the Woods Hole Oceanographic Institution—on the beach. It was at once a misfortune for the late-season Cape Cod tourist trade, a rare opportunity for John M. Teal and his associates of W.H.O.I.'s Biology Department, and—as time proved—a lethal catastrophe for uncounted fish and crustacea on the east shore of Buzzard's Bay.

No recent oil spill has occurred more conveniently close to a scientific institution prepared to study its effects, and Dr. Teal and his colleagues determined immediately to take advantage of their fortunate misfortune. Ever since the oil began coming ashore on September 17 they have monitored the beaches near Wild Harbor and the marshes of the Wild Harbor River in Falmouth, and they will continue to do so for many months to come.

As of early spring, their conclusion—reported by Dr. Teal at the annual meeting of the W.H.O.I.'s Associates in Boston in April: "The oil is more poisonous, and the damage far more extensive, than we had expected." Its effects are still obvious.

Detergents were used to disperse the oil in some areas of Falmouth; but Dr. Teal believes the detergents only made the situation for sea life worse: the oil was simply dispersed by the detergents so that it could penetrate more deeply into every crack and pore. Indeed, he said, in Wild Harbor itself the oil seemed to be emulsified and

Dead fish, crustaceans, and marine worms which collected in tidal pools at West Falmouth, Mass., following the spillage of about 70,000 gallons of fuel oil. (Photo: G. R. Hampson, Woods Hole Oceanographic Institution)

only traces of it appeared after two days, but it had obviously penetrated the 40-ft.-deep harbor from surface to sediment.

Two days after the accident, the high tide line in Wild Harbor was "littered with dead animals—a whole windrow of clams and mussels," Dr. Teal said.

The oil affected not only animals at or near the surface; it poisoned lobsters and clams, brought flounders up from the bottom into the surface waters in search of relief. Of nearly 1,700 animals brought up by a single oceanographic dredge off the entrance to Wild Harbor within three days of the spill, 94 per cent were dead; 60 lbs. of dead fish were collected from 500 meters of beach.

Dr. Teal and his colleagues determined almost immediately to make a continuing systematic study of the oil and its effects, both short- and long-term. They have monitored the harbor and river conditions through the fall and winter. Now, Dr. Teal said, oil can be detected in the first 2 ft. of marsh sediments and 4 in. into the bottom sediments of the harbor, where the oil still represents 1 per cent of the bottom material.

On September 19 Dr. Teal and his associates found 188 snails in a small area of the Wild Harbor River salt marsh; normally there might have been twice that number. By September 26, only 90 survived in a similar area, by December 7 none. No lobsters have been taken in Wild Harbor since September; the scallop season was closed prematurely last fall because of the scallops' oily flavor; the marsh grass along the river appears dead.

Why has the oil been so slow to yield to the bacteria which will eventually break it down? How long will it keep Wild Harbor a lifeless desert? Can contaminated animals purge themselves of oil, or grow immune to it?

A Galactic Source of Life—But How?

The "empty" space in and around our galaxy is not only not empty; it contains a remarkable assortment of molecular chemicals, including all those necessary for the development of primitive forms of life. Identification of these compounds—and discovery of areas in galactic and intergalactic space in which they are highly concentrated—are among the major achievements of astronomy during the 18-month period which is just now ending.

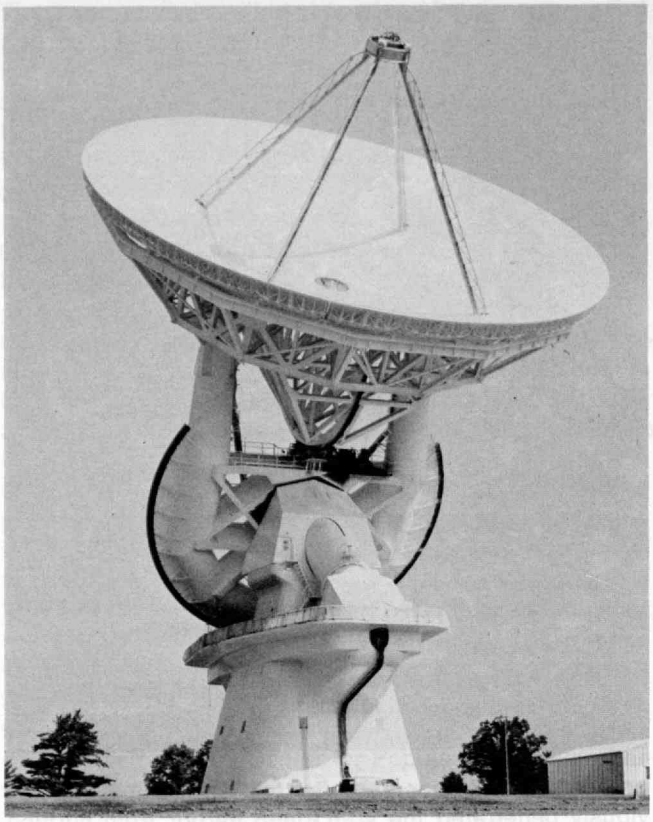
In December, 1968, a team of radio astronomers from the University of California reported the presence of ammonia in the interstellar clouds of hydrogen, which themselves had been identified in the 1950's. Earlier the OH radical, an atom-to-atom combination of oxygen and hydrogen, had been identified by M.I.T. and Lincoln Laboratory radio astronomers, and optical astronomers had found evidence for molecules of carbon linked to hydrogen—CH—and nitrogen—CN.

Another new piece in the jigsaw puzzle was added in March, 1969, when scientists using the 140-ft. radio telescope at the National Radio Astronomy Observatory first reported the presence of formaldehyde in the galaxy, and it is now known to be distributed widely. At that time the four astronomers—Ben Zuckerman of the University of Maryland, Patrick Palmer of the University of Chicago, and David Buhl and Lewis E. Snyder of the N.R.A.O.—noted that formaldehyde was the "first organic polyatomic molecule ever detected in the interstellar medium." Its widespread distribution, they said, suggested that "processes of interstellar chemical evolution may be much more complex than previously assumed."

They concluded that formaldehyde was the missing link in the chain; that life could, in fact, "originate in the gases from which a planet forms." Thus, they said, "it [is] highly likely that life similar to ours has evolved on other planets. We expect that many new interstellar molecules will be found in the near future which will shed more light on this fascinating subject."

The four astronomers fulfilled their own prediction in

The 140-ft. radio telescope at the Green Bank, W. Va., facility of the National Radio Astronomy Observatory has played a leading role in the discovery of chemical compounds in space. It was used in the first detection of formaldehyde (March, 1969) and of the carbon-13 version of the same compound seven months later.



October, 1969, when—using the same equipment—they identified a concentrated galactic source of formaldehyde containing the isotope carbon-13, in contrast to the more common carbon-12 formaldehyde previously observed.

This identification had special interest because the normal amount of carbon-13 in our solar system, including the earth itself, is one atom for every 90 carbon-12 atoms; but the new observations suggested that in the galactic center there was at least one region where the ratio changes from 1:90 to 1:10. The carbon-13 is presumed to be associated with star-formation processes; the astronomers suggest only that "very massive stars may have been formed in the center of the galaxy and that conditions in the galactic center are very different from our own local solar neighborhood."

Carbon monoxide joined the squad in April this year. K. B. Jefferts, A. A. Penzias, and R. W. Wilson, all of Bell Telephone Laboratories, found the molecule—in the guise of a single peak at 115 GHz—using a newly developed Bell receiver in conjunction with the Kitt Peak 36-ft N.R.A.O. radio telescope. Dr. Jefferts' team has found CO in all of the five H-II regions they have observed—these being relatively dense clouds of hydrogen plasma where new stars may be evolving.

Dr. Jefferts searched for the monoxide as a likely end-product of cosmic chemical processes such as the dissociation of formaldehyde. He views the abundance of CO (as against the more stable CO_2) as evidence that the cosmic chemical species are not in a state of equilibrium, but are parts of an ongoing process.

Water in the Sky

Water vapor is among the precursors of primitive life which astronomers now recognize in galactic and intergalactic space (*see above*). Now several of the two dozen or more water vapor sources in the sky—they are in general closely associated with sources of OH radical molecules—have been pinpointed with remarkable accuracy, and they have been given the name "linars," a word which combines "(spectral) line" and "star" in the same word-making fashion that produced such terms as "pulsar" and "quasar."

Using very-long-baseline interferometric techniques, a group of collaborating radio astronomers from M.I.T. and the U.S. Naval Research Laboratory has identified five separate water vapor linars in the "radio constellation" W49, some 45,000 light years from the solar system; two in the constellation Orion, about 1,500 light years away, and one each in the W3 radio portion of the constellation Cassiopeia and in the constellation Canis Majoris. In all but one case (W3), the linars were no more than .003 arc-second in angular diameter.

All the targets were associated also with OH emissions. All are presumed to be the amplified results of intragalactic maser mechanisms, and the radio astronomers say it is "likely" that in some of these regions the radiative processes which result in linars are evidence of stars being formed. The term linar is used as designation of a point in the sky which emits radiation of a specific wavelength which shows up as a narrow line (hence "linar") on a radio spectrum.

The long-baseline interferometry technique involved simultaneous observations from radio observatories at Maryland Point, Md., Green Bank, W. Va., and Tyngsboro, Mass. (the M.I.T. Lincoln Laboratory Haystack Facility). Data processing was performed at the Haystack facility.

Scientists involved include Bernard F. Burke, Professor of Physics at M.I.T.; D. Cosmo Papa of the M.I.T. Research Laboratory of Electronics; George D. Papadopoulos, Research Assistant in Electrical Engineering at M.I.T.; Philip R. Schwartz, graduate assistant in the M.I.T. Department of Physics; Marion L. Meeks and J. M. Moran of the M.I.T. Lincoln Laboratory; and S. H. Knowles and W. T. Sullivan of the U.S. Naval Research Laboratory.

Red at Night . . .

Are our sunsets growing brighter? And if so, do they signal hazards, or simply greater beauty?

Frederic E. Volz of the Air Force Cambridge Research Laboratories has made a ten-year career out of trying for objective, standardized twilight measurements in order to correlate twilight luminosity with the upper atmosphere's dust burden. Measurements at A.F.C.R.L. and the Blue Hill Observatory near Boston have been supplemented by reports from Germany and from cooperating volunteers in latitudes from Northern Canada to Chile.

The eruption of the volcano Agung in Bali in 1963 led to a marked increase in the brightness of sunset skies caused by volcanic dust in the stratosphere, especially in the southern latitudes. Indeed, the dust may have been so heavy as to reduce solar radiation reaching the earth by 15 per cent in those areas, says Dr. Volz, and by 9 per cent in the northern midlatitudes.

Several smaller volcanic eruptions since 1963 have served to sustain twilight intensities at relatively high levels since then. Now Dr. Volz hypothesizes that colorful sunsets may become more and more familiar, as aerosols accumulate in the stratosphere from supersonic aircraft and other sources of pollution. Changes in twilight luminescence may come to signal changes in the delicate chemistry of the upper atmosphere—and perhaps, as a consequence, changes in the earth's heat balance.

Engineers' Society for Society?

Engineering needs a new national professional society —not to press its skills on a nation more aware of science, but to awaken the engineering community to its own broader responsibilities.

At the A.A.A.S. meeting in Boston this winter, Robert H. Roy, Dean of Engineering Science at the Johns Hopkins University, proposed that engineering needs an A.A.A.E. —an American Association for the Advancement of Engineering. "In engineering," said Dean Roy, "technology is no longer enough. Cost-benefit calculations, once bounded by the interests of the entrepreneur or the state, must now be unbounded in behalf of mankind."

Supporting the proposal, Warren E. Alberts, Vice-President of United Air Lines, said that "the existing disciplinary societies have done a good job of sharpening their members' professional skills. But few forces are at work to broaden the engineer's concerns, to cross-fertilize his skills, or to involve him in sociopolitical activities," he said. "If the doctor and lawyer need to bond together as professionals and as specialists, how much greater the need for the individual engineer?"

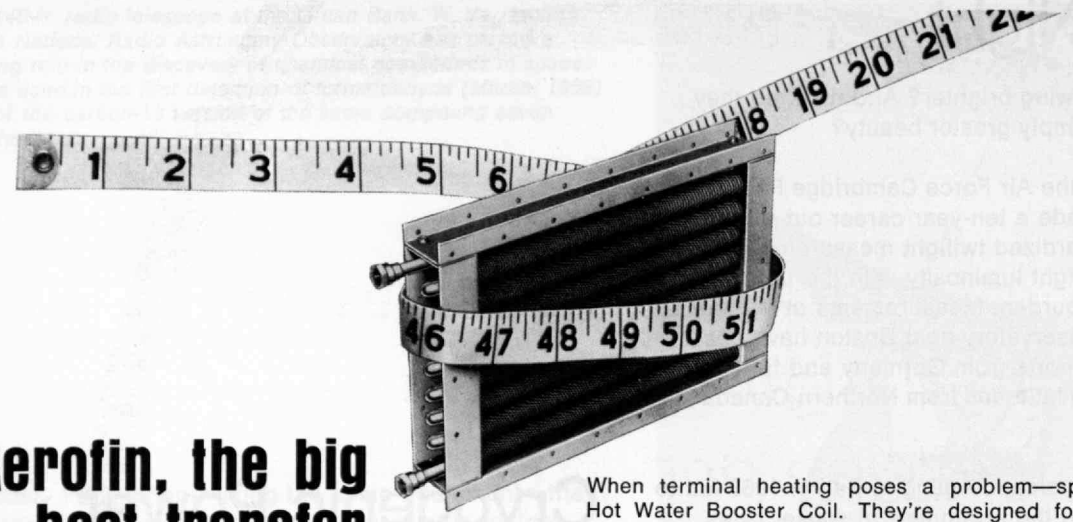
Cryogenic Power

Operating temperature is the limiting factor in many components of modern electric power systems—generators, alternators, transformers, and transmission lines—and present technology is simply proving inadequate to meet the demands for increased capacity in power systems. Hence the effort to apply cryogenics —the science of extreme cold—summarized this spring by Herbert H. Woodson, M.I.T.'s Philip Sporn Professor of Energy Processing, at the annual convention of the Institute of Electrical and Electronics Engineers.

Superconductivity—the property by which metals at extremely low temperatures lose their electrical resistance even to current densities as high as 500,000 amperes/sq. in.—is one phenomenon of obvious interest. Present evidence suggests that superconducting field windings might increase to 5,000 megawatts the present ceiling of about 1,500 megawatts on a single-shaft 3,600-r.p.m. turbine generator, Professor Woodson told the I.E.E.E. He reported successful operation in the M.I.T. Energy Processing Laboratory of an 80-kv. generator with a conventional copper armature cooled to superconducting temperatures by liquid helium, and a larger test machine rated at 800 to 1,000 kv. will be ready for research by fall, he said.

Cryogenics has obvious application to transformers, said Professor Woodson, for reducing size and cost and increasing efficiency. Less volume of both conductor and insulation would be required for low-temperature operation, and this would help reduce overall transformer size, which is now becoming a problem simply because of transportation restrictions.

Professor Woodson admitted that "it takes some imagination" to conceive of cryogenic or superconducting power transmission lines, and he dismissed as impractical the application of cryogenics to overhead power lines. But research is underway on the use of liquid hydrogen or nitrogen circulating in underground power transmission cables to increase their efficiency, reduce materials, and simplify construction. In this case, he explained, the liquid is proposed to act simply as a powerful and efficient refrigerant, removing the excess heat which otherwise limits the capacity of underground systems.



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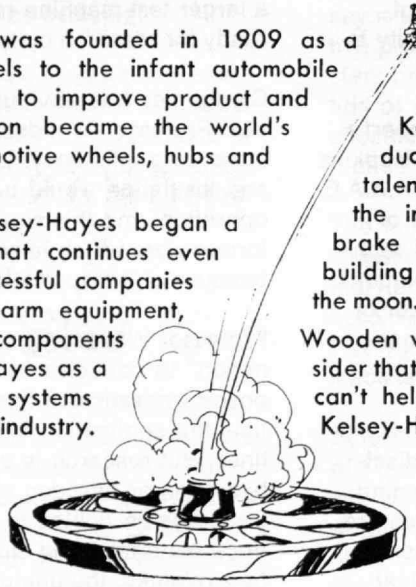

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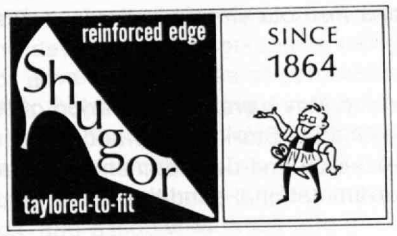

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Divestment Without Compromise

Given the decision to attempt it, how do you divest a creative engineering laboratory, which is in fact a major national resource, from its parent academic institution without compromising the laboratory's programs and employees in their service to the nation?

Of the alternatives, Professor Albert G. Hill, Vice-President for Research of M.I.T., dismisses two almost at once: selling the Draper Laboratory to a single company "would not be viewed in the best interest of the U.S.," he told a press conference following President Johnson's statement to the faculty on May 20 (*see right*), "and we are acutely aware of our responsibility to the nation." He noted that not-for-profit corporations—such as Draper Laboratory might become—are "presently not popular with the Congress." Could the Laboratory be financed and operated by a consortium of U.S. companies on the pattern of Comsat? Perhaps, Professor Hill said; but would such an arrangement be of interest to industry?

The decision will be made by a Board of Directors which the M.I.T. Corporation has established to develop a two-stage divestment of the Charles Stark Draper Laboratory from M.I.T. In stage I the laboratory will be operated as a wholly separate and independent division of M.I.T.; in its second stage its separation will be complete.

Professor Draper himself is now President Pro Tempore of the Laboratory, and almost surely the Board of Directors will move promptly to elect him President—and therefore the chief operating officer of the Laboratory. Other members of the Draper Laboratory Board of Directors appointed by the Executive Committee of the Corporation: Robert A. Charpie, President of Cabot Corporation; Professor Hill; Carl Kaysen, Director of the Institute for Advanced Study (Princeton); James McCormack, Director of the Communications Satellite Corp.; Charles L. Miller, Associate Dean of Engineering at M.I.T.; Emanuel R. Piore, Vice-President and Chief Scientist of I.B.M.; David W. Skinner, Vice-President and Vice-Chairman of Polaroid Corp.; Robert C.

Divesting Draper Laboratory: Limits of Academic Research

It was in October, 1969, that the Executive Committee of the M.I.T. Corporation directed that no M.I.T. laboratory should undertake new work "in the design and development of systems intended for operational deployment as military weapons" *(see* Technology Review *for October/November, p. 93B),* a statement that went further than any recommendations of an earlier faculty-student-alumni review panel considering how the Institute should manage its special laboratories.

Now, seven months later, that directive of the M.I.T. Corporation has proved to be the decisive factor in President Howard W. Johnson's decision to divest the Charles Stark Draper Laboratories from M.I.T. but to maintain the Institute's "commitment to research related to the security of this nation."

The earlier Review Panel on Special Laboratories, chaired by William F. Pounds, Dean of the Sloan School of Management, had last spring established five conditions for maintaining the Draper and Lincoln Laboratories at M.I.T. (*see* Technology Review *for June, pp. 72A-72D)*:

1. The Institute should continue defense-related research but the balance of work conducted in the two special laboratories should be shifted substantially in the direction of domestic and social problems;
2. Classified research—though it will continue—should be reduced to a minimum;
3. There should be more effective ties between faculty and students and the two laboratories;
4. A standing committee of faculty and students should review laboratory programs and provide close contact between the laboratories and M.I.T.'s teaching activities; and
5. The relationship of laboratories and Institute should be reviewed regularly in the future.

The seven months between October and May have been a period of testing: Could M.I.T. continue to operate the Charles Stark Draper and Lincoln Laboratories—together a $120 million research and development undertaking—within these guidelines and under current national conditions?

The decision was for President Johnson to make. He did so, he told the M.I.T. faculty on May 20, on the basis of five tests:

1. Could the Draper and Lincoln Laboratories continue to function under the directives of the Review Panel and the Executive Committee of the Corporation?
2. Would funds be available for nondefense work which would fully challenge the laboratories' unique capabilities?

3. Would the laboratories choose to do that work, were it available?
4. Could a student-faculty standing committee work with the laboratories to effectively review their programs and increase their academic interaction?
5. Would present and future contractors accept the specified conditions?

President Johnson's decision was that M.I.T. could continue to be responsible for the Lincoln Laboratory but not for the Draper Laboratory. The Corporation Executive Committee's directive could not be applied to the Draper Laboratory, he said, "without major retraction in employment levels at the Laboratory and without a serious loss of capability in what this Laboratory has set itself to do in the years ahead.

"We do not have the right to hurt the capability of the Laboratory by continuing to impose a restriction that neither the Laboratory nor its contractors are willing to accept," President Johnson told the faculty.

Victor K. McElheny, Science Editor of the *Boston Globe,* called President Johnson's decision "a workable compromise between the claims of idealism and practical duty to the government. . . . The decision amounts to a declaration that the institution does not want to sponsor work on specific new weapons systems but still feels a duty to support general development work of importance to the military.

Constraints Relieved But New Burdens Added

Different philosophies and different funding patterns which distinguish the Draper and Lincoln Laboratories stand behind the President's decision. The Lincoln Laboratory is largely supported under a single contract with the armed services for research and development in space communications, satellite re-entry problems and general research in solid state, data systems, radio physics, and other areas of advanced electronics. The Lincoln Laboratory has no prototype development or systems management responsibilities.

The Draper Laboratory—known at M.I.T. for more than 30 years until November, 1969, as the Instrumentation Laboratory—is a world center for the design and development of guidance, navigation, and automatic control systems for advanced vehicles of several kinds— the Apollo spacecraft, N.A.S.A.'s proposed Orbiting Astronomical Observatory, the Navy's Deep Submergence Rescue Vehicle, and the Navy's Polaris and Poseidon missiles. In addition, three is a program of fundamental research on the components of such systems—flight computers, gyroscopes, accelerometers, bearings, and associated electronic devices and techniques, and there are modest undertakings in related nonmilitary research. Most Draper Laboratory assignments represent "cradle-to-grave" responsibility for total systems—from basic research through development to prototype testing and even in some instances, such as Apollo, to monitoring operation.

To force the Draper Laboratory into the pattern of constraints set for M.I.T. by the Pounds Panel and the Corporation Executive Committee, said President Johnson, "will only do basic harm to the Laboratory and its concept of

Sprague, Chairman and Chief Executive Officer, Sprague Electric Co.; Julius A. Stratton, Chairman of the Ford Foundation and President Emeritus of M.I.T.; Mark C. Wheeler, President of the New England Merchants National Bank of Boston and Alan Pifer, President of the Carnegie Corp. of New York.

The Board's assignment, President Johnson told the faculty, is to seek "in as rapid and short a time as possible the wise and complete separation of the Draper Laboratory" from M.I.T. The task during phase I of the divestment is to develop a plan for complete separation "that protects the rights of all employees in the Laboratory, that allows for some resorting of tasks and individuals, that allows for the taking over of administrative functions, that allows for the funding of the necessary working capital of the new organization, and that—most of all—allows for an effective choice of the form of the new independent body," President Johnson told the faculty on May 20.

Following the announcement by President Johnson, Professor Draper assured newspapermen at a press conference that morale at the Draper Laboratory is "very good." And he pledged his wish "to maintain the most effective possible interface with education. I believe in real-world engineering experience for students," he said, citing his 40-year experience on the M.I.T. faculty.

During a faculty discussion of the issue on May 26, Jerome B. Wiesner, Provost of M.I.T., warned that divestment will not be simple: "Anyone who thinks we are not in for some changes is in for a surprise," he said. But Professor Hill insisted on his optimism. "If we move too rapidly," he agreed, "there will be a shock." And what does he mean by too rapidly? "If you get a shock," he answered, "you have moved too rapidly."

M.I.T. and Social Responsibility

At a community meeting late in May, Jerome B. Wiesner, Provost of M.I.T., made it clear that M.I.T. never considered a unilateral shut-down of the Charles Stark Draper Laboratory's work on guidance for such military projects as M.I.R.V. and S.A.B.R.E.

Any attempt to force a shut-down of such work, he explained, would simply have broken up the Draper Laboratory team, leading inevitably to weakening the support which could be given to U.S. space and defense projects depending on this the technology of inertial guidance.

Dr. Wiesner was asked how he reconciled M.I.T.'s policies on defense work—and especially the Draper Laboratory's role on M.I.R.V. and S.A.B.R.E., with his own opposition to any U.S. commitment to these weapons (see *Technology Review*) for May, 1970, pp. 38 ff.). His reply was recorded by Victor K. McElheny, Science Editor of the Boston Globe:

"I don't believe I should use my position in this institution to subvert a policy of the government, even if I disapprove. . . . That's where my morality takes me.

"We have a social responsibility despite individual disapproval of government action. Many don't believe this, but some of us who have responsibility for M.I.T. still do."

how to apply advanced technology," an act which he said "would clearly be irresponsible." Hence the proposal for divestment of the Draper Laboratory through a procedure designed "to protect this national asset, its personnel, and the Institute" (*see left*).

To his faculty audience, hushed with expectancy, President Johnson noted that the decision will impose burdens of several kinds upon M.I.T. Among them will be financial burdens—some immediate, more (up to perhaps $5 million a year, the amount M.I.T. now receives to manage Draper Laboratory's affairs and provide its quarters as part of the total administrative structure of the Institute) as divestment is completed.

Professor Albert G. Hill, Vice-President for Research at M.I.T., recalling the Institute's continuing need for a laboratory in which students and staff of the School of Engineering may gain experience in large-scale systems engineering, said it was "not a happy day for me." He also noted, however, his hope that students and staff who wish to do so will still be able to participate in Draper Laboratory activities even after divestment is complete).

And Michael J. Marcus, '68, a graduate student who has been serving on the Standing Committee on the Special Laboratories during this seven month period and was earlier a member of the Review Panel, told the faculty that "education will only suffer as a result of this action. We are losing a close tie with a valuable educational resource." But the decision, he said, was inevitable given the President's directives and the "senseless ordering of national priorities. We should all do our utmost to try to influence our political system to bring some rationality to our national priorities," he told the faculty.

In his faculty statement, President Johnson emphasized M.I.T.'s continuing intention to be "at the edge of the new and broad opportunities of a developing technology. We have played key roles in the past and will continue to do so in the future," he said.

"Our decision continues our commitment to research related to the security of this nation. But it is clear to me that—largely—new emphases in medicine, in environmental quality improvement, in the urban fields will require new agglomerations of faculty and students and staff in laboratories created by their special interest and talents. And in time these new laboratories, too, may need to be allowed to to their own way."

In other words, President Johnson's message is that—just as the Lincoln Laboratory spawned the Mitre Corporation in 1958 to attend to establishment and operation of the SAGE air defense systems which had been developed at Lincoln, so the Draper Laboratory will have its independence to prosecute applications of the principles of inertial guidance which have been so brilliantly developed under the direction of Charles S. Draper, who is now Institute Professor, Emeritus, and President Pro Tempore of the Charles Stark Draper Laboratory.

Charles L. Miller, who was named Director of the Draper Laboratory last fall to press its effort to obtain nondefense assignments which would be compatible with the Laboratory's traditions and interests, will resume full-time his duties as Director of M.I.T.'s Urban Systems Laboratory and Associate Dean of the School of Engineering.

The Science Action Coordinating Committee (S.A.C.C.)—M.I.T.'s version of the science activist movement in the U.S.—began its disenchantment with itself during a Conversion Conference at M.I.T. in November. Instead of providing the serious discussion which S.A.C.C. promised, the meeting was disorganized and largely superficial. One bright moment came when a group of helium-filled balloons was liberated in the auditorium. Another occurred (see next page) during a discussion of token integration and token rights for women as one panelist stripped to a placard reading "Token Nude" and rejoined the group on stage. (Photos: Richard Koolish)

Science Radicals: Can Non-Violence Be Non-Violent?

At a time when many of the nation's professional organizations are discovering groups of radical reformers in their midst (sociology, modern languages, psychology, and political science), it is hardly surprising that similar groups have cropped up in science and technology schools as well, including M.I.T.

M.I.T.'s "native" science radical group is the Science Action Coordinating Committee. In the last 15 months, by its visible (sign-waving) and articulate (leaflet, newslettering) presence, S.A.C.C. managed to become a noticed body of opinion at the Institute.

S.A.C.C. is a coordinating committee; thus it is small—with at most 20 people working actively. But it also has a considerable following of occasional members who participate more or less, depending on mood, the issue, and available time.

The term "radical" applies only partly to S.A.C.C. As one member says, many people in it think of themselves as scientists first and radicals second. Thus, the group can adopt such establishment issues as the scientific manpower crisis while opposing M.I.R.V. S.A.C.C. was founded alongside a faculty group, the Union of Concerned Scientists, when both groups sponsored the March 4, 1969, research "strike" and conference at M.I.T.

After the success of March 4 (where George Wald gave his famous speech, "A Generation in Search of a Future"), S.A.C.C. conducted abusive campaigns protesting war research and R.O.T.C. at M.I.T. and quickly achieved a peak of influence at the Institute. Throughout the spring a year ago S.A.C.C. had a noisy part in the community debate about M.I.T.'s special laboratories

Has the Tide of Protest Crested?: One Student's Views

by Stephen H. Kaiser

The following view of campus affairs was written for Technology Review *by Stephen H. Kaiser, '65, an M.I.T. graduate student in mechanical engineering from Cambridge, Mass. He has been for several years Editor of the* Catalyst, *the M.I.T. graduate student newspaper, and he has been a close observer of the Science Action Coordinating Committee (S.A.C.C.), the organization founded by "activist" graduate students nearly two years ago. This spring he received the Compton Prize, the highest award for community service given by M.I.T.*

This year at M.I.T. has been marked by fluctuations in political actions and alliances, an ebb and flow of the radical tide, as many students have shared the discovery that "building a radical movement" is as much the anguish of shattered hopes as it is the excitement of anticipated change.

By last fall, many members of S.A.C.C. (*see left*) had concluded that the only hope of change and realignment of M.I.T. priorities lay with the Institute administration, which alone seemed to have the power and willingness to change. The faculty and alumni had been approached without real communication or action, and these frustrating encounters had shattered most hopes.

During the spring of 1969 the faculty had shown themselves willing to make some moves to maintain their image as "good guys," but the response was inadequate for impatient students interested in straight talk and honest but simple solutions on such questions as R.O.T.C., military systems research, and Defense Department alliances.

The alumni, too, tossed away their chance at the June, 1969, Alumni Day at a meeting arranged literally on the spot, that day. The combination of anguished belligerence by students, abusiveness by some nonstudent hangers-on invited by S.A.C.C., and superpatriot diatribes by a handful of ex-World-War-II alumni led to a badly fractured "dialogue"—in effect a polarizing alternating monologue—that ended when a majority of grumpy alumni wanted to watch a movie on the Apollo flight rather than talk with students. Many alumni I talked to on that June day were in fact disgusted with the narrow-mindedness of some of their fellow alumni; but they could only quietly shake their heads. The student activists could remember only the angry speakers, just as many angry alumni today can remember only the distorted words of columnist Joseph Alsop.

Living under the Nuclear Shadow

Many faculty and alumni make frequent, proud references to the role of M.I.T. and of technology in World War II. "What about Hitler?" they ask. "What about Vietnam?" the students respond, and

there is little communication. Today's students have little feel for World War II; if anything, they think of Hiroshima or the bombing of Dresden. Unlike their elders, they have no World War II memories and triumphs to revel in. They see the draft and napalm, not D-Day, Hitler, and Tojo. They have lived under the nuclear shadow all their lives, and they live very much for the present and the near future.

Yet today's student—including the typical member of S.A.C.C.—is caught in a dilemma. Three years ago he was saying that the war in Vietnam is all wrong, and that the air is polluted. Today everyone agrees with him, but he is still scorned as a filthy hippie or a dangerous radical. Like old re-run movies, the protests and the disruptions play out their time at one campus after another. On each campus, the radicals find that protest gets them attention and recognition—even some action in response to certain demands —but it usually degenerates into random "freaking," vandalism, belligerence, and petty terrorism that has horrendous "political vibrations."

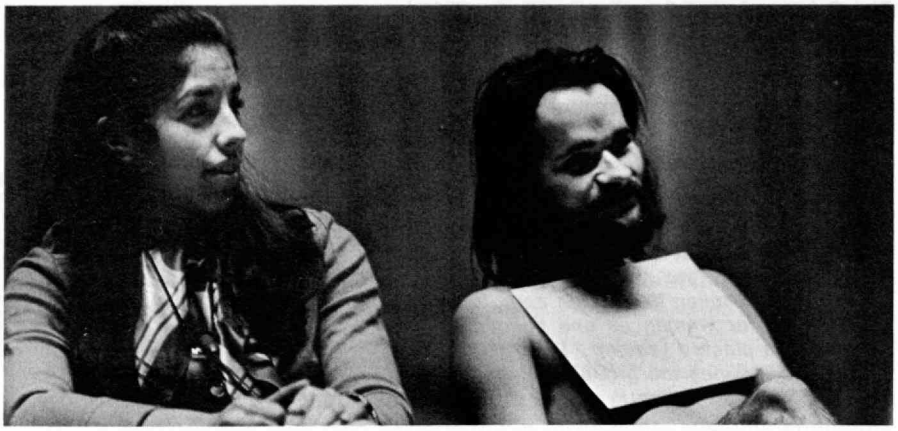
So the Great Movement begins to fall apart; momentum is lost, squabbling begins; amnesty replaces political issues; people become tired of disruption and repetitive speeches, just as they become tired of space shots. Boredom, apathy, and backlash set in. "Trashing" replaces marching. Highly frustrated students talk loosely about bombings, others rationalize "copping out"—that nothing they do will amount to anything, so why not trip out on drugs, even heroin . . . who cares?

But others see the handwriting on the wall and realize that they must try to communicate better, that they must show better discipline and rule out disruptive "freaking," that quiet persistence can have a large long-term effect on stubborn old-guard attitudes.

The Old and Young Together

I have a theory that we may resolve many of our problems through the efforts of some wise old heads—those alumni who went through both World Wars I and II. They can recall the ingloriousness and the horror of the 1918 "war to end all wars." They went through the wild excesses of the 1920's and the flapper era, which gave them perspective by which to judge the Depression.

It is the intermediate generation which bothers me—men who saw World War II rescue them from the Depression and who reaped all the glories of victory and technology, who today constitute the insecure generation. I suspect that our society will survive because the very young and the very old will get together and will combine energy, confidence, and patience with meaningful experience.



and their defense research assignments; Jonathan Kabat, a graduate student in biology who was a S.A.C.C. leader, was himself a member of the study panel on special laboratories (the Pounds Panel).

Subsequently, S.A.C.C. activities quieted. Academic change comes with deliberate speed, and committees on special laboratories, R.O.T.C., and curriculum problems make poor targets while the hard work of decision-making progresses.

In June, 1969, S.A.C.C. tried to bring its politics into M.I.T. alumni affairs. Long after sessions for the 1969 Alumni Homecoming were planned, S.A.C.C. proposed that it, too, participate in a panel on technology related to "the human purpose." This proposal ruled impractical, S.A.C.C. invited several other dissident groups in the Greater Boston area to join in a diversionary discussion nearby. Few "activists" came, but pressure developed and there was a noisy confrontation with very little communication between a core of some 40 students, some outsiders, the administration, and bewildered alumni.

Last fall, S.A.C.C. refused on grounds of tactics to join the broad, militant November Action Coalition to oppose defense research at M.I.T. Many S.A.C.C. members did participate in some events, however, and Mr. Kabat is credited with at one point dissuading a crowd of 600 demonstrators from taking violent action against the M.I.T. President's office, urging them to make a peaceful march instead.

S.A.C.C.'s own project this fall was a December Conversion Conference, in many respects an effort to repeat the success of March 4, 1969. Such success eluded the planners; except for Professor Wald's repeat appearance (which lacked the charisma of his first), the conference played chiefly to "believers" in the S.A.C.C. cause, and it became a superficial forum which failed to explore the real issues in conversion.

S.A.C.C. emerged weak and divided; in the aftermath of the conference there were upheavals; the pressure of academic work asserted itself; and the original S.A.C.C. leadership became inactive.

Now S.A.C.C.—admitting in its own literature that its "events since the Conversion Conference have been disheartening," is attempting a comeback. The new leaders are not graduate students in science but undergraduates—many of them in the humanities. One—John Rees, an M.I.T. junior—is concerned to regain S.A.C.C.'s lagging momentum ("It has a respected name, and we must preserve that"). He is focussing on M.I.T. ("It has a vested interest in high technology") and talks boldly of taking power "out of the hands of the Corporation," while rejecting violence as a tactic.

If this sounds somehow inconsistent, consider, too, Mr. Rees' statement about S.A.C.C.'s future role: "It's just important that they know we're here, that's all."

Not a Special Elite

Dr. Jonathan Beckwith, the 34-year-old Harvard molecular biologist who was this year's recipient of the Eli Lilly Award given at the Annual Meeting of the American Society of Molecular Biologists, concluded his award address with a statement of his views on the responsibilities of scientists. His announcement that he was presenting the award money to the Black Panther Party was greeted with silence. But his final words—"Scientists are not a special elite; we must recognize that inbred assumption for what it is, and ally with other groups without assuming a position of superiority"—were followed by a standing ovation from about one-third of the audience, which filled the Sheraton-Boston's Grand Ballroom.

Most of Dr. Beckwith's address was an account of his field of research—the mechanisms that regulate the "expression" of genetic information, or in other words, what decides whether a particular gene is brought into action. To carry out really convincing experiments on the processes whereby a gene's information content is translated into RNA, and thence into the protein which it specifies, one would like to have a pure sample of the DNA of that particular gene.

A few months ago Dr. Beckwith's team was able to report the preparation of a pure sample of the gene responsible for the synthesis of lactose in the bacterium *E. coli.*

"The manipulation of genes practically at will has been a lot of fun," said Dr. Beckwith, "and there is a strong temptation to spend all one's waking hours at it. This is a temptation we must avoid."

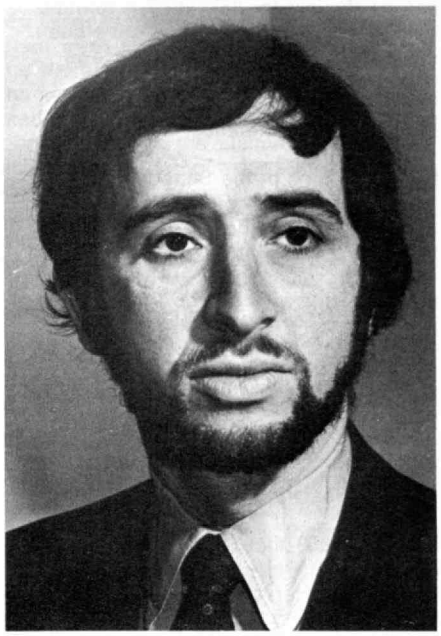
As the day of his award presentation approached, he said, he had begun to wonder about three questions. First, did not the honoring of an individual tend to give a false picture of how research was performed? (His address was filled with acknowledgments of colleagues and other teams.) Second, could not the prize money ($1,000) be put to better uses? Third, what were the political implications of a situation in which a pure researcher found himself in receipt of a reward given by an industrial company?

Giving himself the choice of either turning down the award or using the occasion to express his concerns, he chose the latter. As to his third question, he commented that an industrial company giving such an award tends strongly to equate service to science with serving the ends of a few rather than the majority. His second point was answered by his dividing the prize money between the Black Panthers' health-clinic program and their legal defense fund. He described the Panthers as having created a model for a new kind of society, and as having been rewarded by the worst kind of oppression seen in this country in recent years.

"I do not think that scientists have a superior ability to judge what are the problems in our society—but," said Dr. Beckwith after a burst of applause, "we must work together with others—particularly the poor—for radical political change." Scientists should offer their expertise to those most in need of it.

Dr. Beckwith is something of a moderate. Dr. James Shapiro, who worked with him on the isolation of the *E. coli* lac gene, has abandoned research completely to devote himself full-time to political work.

Ambivalent about accepting the Eli Lilly Award for his recent isolation of a pure sample of a gene, Dr. Jonathan Beckwith decided to use the money to express his social and political concern. He sent the money to the Black Panther Party, to be divided between their community health clinic and legal defense fund. The Panthers' attempts to implement their vision of an alternative social order, he noted, have been met with increasingly violent repression. He hoped by splitting the prize to aid both struggles a little.



From Biomathematics to Health Sciences and Technology

The path which has led to the Harvard-M.I.T. School of Health Sciences and Technology is complex and tortuous —but constant in its course toward the ultimate joining of technology to medicine. Here are some of the highlights as recorded by Donald R. Giller, a writer at the Charles S. Draper Laboratory, in his graduate thesis for Boston University's Science Communication Program.

The story may, in fact, begin before the founding of M.I.T. As William M. Siebert, Professor of Electrical Engineering, speculates in the April issue of *Technology Review* (p. 38), M.I.T.'s founder William Barton Rogers may have been inspired by Claude Bernard's views of experimental medicine; Bernard's "head and hand" may have become M.I.T.'s "mens et manus."

But the origins of the School of Health Science and Technology are more recent. Mr. Giller begins his account with the years after World War II, when efforts at cooperation between M.I.T. and medicine yielded the Physics Research Laboratory at Massachusetts General Hospital and the Eaton-Peabody Laboratory of Auditory Physiology at Massachusetts Eye and Ear Infirmary. Even before the war the Institute was working with high-voltage X-ray therapy, in association with Massachusetts General Hospital and the Lahey Clinic.

It was in 1959 that Dr. David Rutstein, Ridley Watts Professor of Preventive Medicine at Harvard Medical School, proposed a research program on the application of mathematics to medical practice, and so began an informal collaboration between M.I.T. and Harvard faculty members in "biomathematics."

By 1964 Gordon S. Brown, then Dean of the School of Engineering, had appointed an ad hoc committee to survey current activities and recommend a future course for M.I.T. in biomedical engineering. The group concluded "conservatively" that interest in the School of Engineering "might grow to a level where it could involve 10 to 20 per cent of the faculty and students." But a separate department or undergraduate curriculum was not recommended; instead, every student should plan his own program to meet his own needs, with help simply from a steering committee to coordinate activities and plan educational offerings. The steering committee, duly appointed, became the Committee on Engineering and Living Systems, of which Walter A. Rosenblith, Professor of Communications Biophysics, was Chairman until 1966.

Five years earlier, Mr. Giller claims that M.I.T. had rejected tentative offers to receive Boston's University's School of Medicine, which was then said to be suffering from inadequate financial support. The timing of the offer was

Engineering Another Link

Despite their common frustrations with the current status of the nation's health care system and the application by the other of each's area of expertise (*see* Technology Review *for April, 1970*) technologists and managers on the one hand and medical scientists on the other have a modest record of joint accomplishment. Now a new effort to improve the record has been launched by M.I.T. and the Harvard Medical School, whose faculties have approved the establishment of a new joint School of Health Sciences and Technology.

The plan for the new School has been developed during the past two years by a joint committee of Harvard and M.I.T. faculty under a planning grant from the Commonwealth Fund. Assuming its final acceptance by the governing boards of both universities, which is expected this spring, it will begin educational and research programs next fall—and will also begin the task of raising resources to support a faculty and provide necessary facilities and construction.

In its report to the two faculties, the Joint Committee said that "despite the commitment of a growing proportion of our national resources to health needs, there is an increasing gap between [the expectations of society] and the capacity of our health care system to meet these needs. To a significant degree, this gap derives from the fact that so little of our technological and managerial potential is reflected in the ways in which physicians practice, or hospitals provide for the sick, or public health agencies address health problems."

The Committee envisions a school capable of undertaking undergraduate and graduate teaching and research—including large projects—integrating management and the physical and social sciences, engineering, computer science, medicine, and the related biological sciences. For example: How do you prepare hospital administrators who know enough management, medicine, sociology, and psychology to operate a hospital so that it fully benefits the community which it is intended to serve?

The School of Health Sciences and Technology will focus on three related issues:

1. Introducing engineers to the medical applications of their skills.
2. Providing a richer background in engineering and the physical sciences for physicians.
3. Development of new concepts of medical management and community health care—and—in general—new relationships between health care and technology.

According to present plans the School will offer courses at undergraduate, graduate, and postgraduate levels. Harvard and M.I.T. undergraduates will be able to study in the School for two-degree programs—the regular under-

graduate degree from Harvard or M.I.T. and a first-level (Master's) graduate degree from the School. There will also be opportunities for postdoctoral work.

In its research, the School of Health Sciences and Technology will concentrate on taking advantage of "the strengths afforded by the two universities, and to providing a setting especially suited to multidisciplinary or large-scale studies," according to the report. Examples cited include a program in environmental health sciences involving such disciplines as earth sciences, various branches of engineering, biology, genetics, human pathophysiology, urban planning, economics, and others; and a program in biomaterials science to study the interaction of various materials with body tissues.

A beginning has already been made. Nine new courses have been or are being developed at M.I.T. and Harvard: introductory physics with illustrative content from biology and medicine; biophysical chemistry; topics in biomedical engineering (neuromuscular control, ultrasonic neural surgery, fluid mechanics of arterial sounds, and collagen as a biomaterial); biomechanics (conceptual, analytical and experimental approaches of physical sciences to the human neuromuscular-skeletal system); fluid mechanics of the circulatory, pulmonary, and ureteral systems; biomedical heat and mass transfer; physical aspects of nuclear medicine, human genetics and hereditary disorders; and an interdisciplinary health services project planning laboratory.

In addition, the School will develop courses in human biology—anatomy, physiology, and pathology. Other proposed topics include political processes in medical settings, computer modeling applied to population genetics, human physiology, and general pathology.

Most faculty in the new School will hold joint appointments with one of the parent institutions; separate School appointments would be considered only "in exceptional cases for the unusual individual whose scientific discipline does not conform to an existing department of either university." Degrees—both graduate and undergraduate—would be given by Harvard or M.I.T.

Annual enrollment is expected to reach between 150 and 200—about 100 in health sciences and technology and 25 each in human biology, medical engineering, and social, behavioral, and management sciences. When it has reached full size the School will thus number between 300 and 400 students.

"Initiation of the program on a sound financial basis," says the Joint Committee on Engineering and Living Systems, "requires the fulfillment of three conditions: raising of approximately $10 million in endowment funds; favorable prospects for raising an additional $40 million; and favorable prospects for governmental and private support for health care, research, and educational programs."

"unfortunate," Mr. Giller writes, since Julius A. Stratton, '23, was just then assuming leadership of M.I.T. and "the future for medicine at the Institute was still very much unsettled."

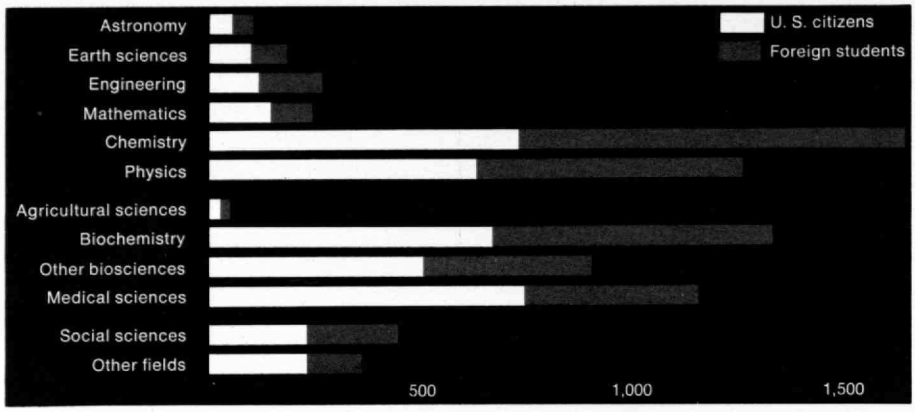
Boston University's name reappears in the chronicle in 1965, when Dr. Richard Egdahl, Head of the B.U. Department of Surgery, and Dr. Robert Wilkins, Head of the Department of Medicine, opened with M.I.T. officials the possibility of a joint program to train biomedical engineers. Once more M.I.T. opted in favor of flexibility, and though there were a number of cross-registrations between M.I.T. and B.U., there were no formal courses or program of collaboration.

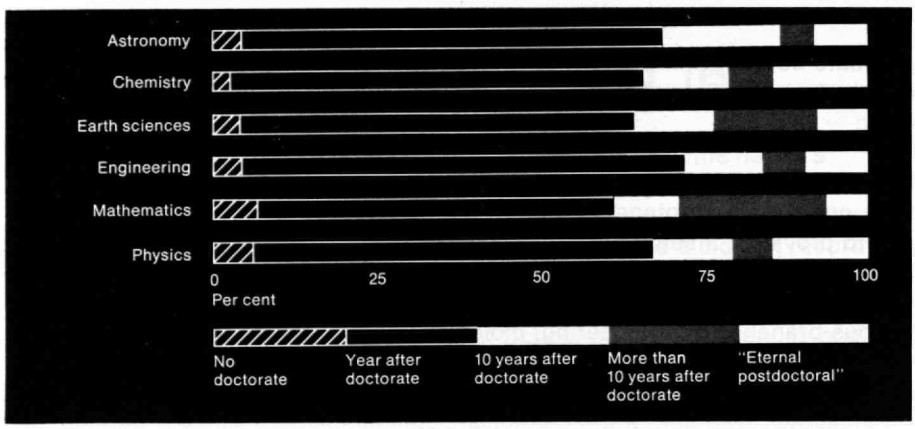
Mr. Giller is convinced that a major grant was discussed with M.I.T. by the National Institutes of Health in 1959, the funds to be used in forming a new medical school at M.I.T. "which would bring to bear on the standard medical sciences all the techniques of engineering, the social sciences, political science, and management." That the plan did not materialize is attributed by Mr. Giller to two causes: funding problems (whatever figure was mentioned would have covered only a fraction of the cost of organizing a new medical school, he says) and the Institute's continuing feeling of inadequacy in the medical field.

Late in 1966, when James R. Killian, Jr., Chairman of the M.I.T. Corporation, was serving as a trustee of the Bay State Science Foundation, there were proposals for a laboratory of biomedical research and development at M.I.T. to stimulate industrial developments. But Mr. Giller concludes that "the cost-effectiveness of such a laboratory appears to have been the stumbling block."

With steady growth during the 1960's, teaching and research linking engineering and medicine throughout M.I.T. and the Greater Boston academic community were by 1967 on the point of "going critical," in the words of Dr. Philip A. Drinker, Research Associate at Peter Bent Brigham Hospital and Lecturer in Mechanical Engineering at M.I.T., who was Executive Officer of the Committee on Engineering and Living Systems. He argued that it was time for another review of progress and future plans, which was subsequently conducted during a two-week period in the summer of 1967 by 71 members of the M.I.T. faculty and staff and 54 medical people from other institutions, including 26 from the Harvard Medical School. At the end of the summer came the announcement that Harvard and M.I.T. "have joined forces to explore the effective use of their complementary resources in the life and health sciences towards the objective of a continuing improvement in our national health."

Postdoctoral study—called "the invisible university" in a new report commissioned by the National Research Council—serves the sciences unequally (see above): more than half of the biochemists who received doctorates in 1967 were planning postdoctoral study, one-third of chemists and medical students, one-fourth of physicists, astronomers, and biologists. But especially in the physical sciences postdoctoral education is increasingly a form of "adult" education (see below). The National Research Council reported that "study or research leaves for mature scholars are universally recognized as important and desirable," but there was "major concern" for those individuals "who make a career of being a postdoctoral"—called "eternal postdoctorals" on the chart.





Toward the "Eternal" Student?

Three years ago, when M.I.T. undertook to investigate the number and status of its postdoctoral fellows—advanced workers pursuing special studies—other institutions quickly assured Sanborn C. Brown, Associate Dean of the Graduate School, that he had no "monopoly of ignorance" on the subject. So began a major national study of what has since been called the invisible university—a two-year effort sponsored by the National Research Council and funded by five agencies of the federal government and by the Alfred P. Sloan Foundation. Robert K. Weatherall, Assistant Dean of the Graduate School at M.I.T., served as Associate Director of the survey project.

A final report just published shows that the invisible university is both large—10,740 in 1967, probably somewhat fewer today—and expensive; but even now nobody is ready to guess at its total cost. As of 1967, more than half of U.S. postdoctoral students were in the medical sciences, 45 per cent were from foreign countries, 30 per cent were in 10 U.S. educational institutions (out of 174 universities which reported one or more postdoctorals in 1967), and nearly 40 per cent continued into postdoctoral work directly upon completing their doctorates. In one field—biochemistry—more than half of the 1967 Ph.D.'s became postdoctoral fellows; in physics and astronomy, the figure was 26 per cent.

As of 1967, most postdoctorals (80 per cent) did their work in universities; some 8 per cent studied in other nonprofit institutions, 7 per cent in government laboratories, 1 per cent in industry, and 4 per cent used American funds for study abroad.

The universities where they studied had no real idea of how much it cost them to have a postdoctoral fellow on the campus. But five different universities agreed "remarkably" on the costs which they independently gave to the National Research Council's study staff: the gross cost to the institution of a postdoctoral fellow was $17,500 in physics, $15,300 in chemistry, $13,000 in biology. Because many postdoctoral fellows are supported by grants for their

stipends and sometimes for some research as well, the net cost to the university was reported as ranging from $8,000 down to zero.

For this money the universities reap several advantages. One university president wrote the National Research Council that postdoctorals "not only enrich the scholarly atmosphere of the sponsoring institution and its members, but they help the institution furnish unusually gifted and well-trained supervision for graduate students . . . and they afford a stimulating association for senior scholars." Over 70 per cent of postdoctorals in 1967 expected eventually to join university staffs, most as members of the faculty.

Though no one knows for sure, the best guess is that the "invisible university" has grown smaller since 1967 principally because of less generous federal research and training grants. At M.I.T., which as of 1966-67 reported 279 postdoctoral fellows (fifth in the U.S.) to the National Research Council, the numbers increased in 1967-68 and 1968-69—but are now on the decrease.

Making Science Political

"I have never seen the American Medical Association bashful in presenting their views. So why should the mathematicians be?"

An M.I.T. student had just asked Charles Wilson Lee of the Emergency Committee for Full Funding of Education why pressure—of the kind Mr. Lee used in support of authorization bills for secondary and higher education in Congress in 1968 and 1969—could not also be applied in behalf of science. To his answer Mr. Lee added a question of his own:

"But what do you say to a Congressman about mathematics?"

And answered it: "No Congressman can stop listening to his constituency. Just tell him why mathematics is important and he will listen. . . . There are no laws against lobbying in the public interest, against citizens bringing the factual situation to the attention of their Congressmen. . . . Everybody has a right to get into the act."

Mr. Lee's Committee was formed when a group of independent education associations joined to fight against reductions in federal support of education which President Nixon proposed shortly after he took office nearly two years ago. His advice to the mathematicians came as he described the successes and frustrations of the effort to gain congressional support for education at an M.I.T. seminar late this spring.

Mr. Lee would undoubtedly admit that education has some built-in advantages over mathematics in any race for congressional attention. For example, education programs as they have been enacted by House and Senate over the years provide a good many of what Mr. Lee calls legislative "locomotives." These are the plans under which federal funds are distributed to supplement local school funds automatically and without strings, and some of them even include support for a cadre of local administrators in the field. Such bills are "locomotives," said Mr. Lee, because every local school board and every parent can see what they give to his children and what they save on his taxes; they thus develop quick, broad, and vocal public support for education, carrying other money measures with them through the congressional funding mill.

Though most of Mr. Lee's activity so far has been in support of secondary school programs, he thinks higher education "is potentially the strongest political organization of all." He cited the position and authority with which college administrators—and especially trustees—can approach the Congress; and there are plenty of "locomotives" available—for example, he said, note "the basic political fact about college loan programs: every son or daughter who gets a loan reaches four or five voters. Institutions don't vote—people do."

Packages and Digits

Both Brandeis and M.I.T. are "on strike" as this is written, so this place—Brandeis—is alive with anti-war activity, a model of nonviolent demonstration. Classes are available for those students who wish to attend, but finals are optional and any student may opt for a grade based on work up to May 5. Meanwhile, the Waltham area is being canvassed by Brandeis undergraduates, and much lobbying is going on in Washington by older students and faculty members. I only hope that all these sincere efforts for peace bear some well-deserved fruits.

Enough for politics. Send speed problems!

Problems

The first selection is from Frank Rubin:

36 Show that the equations
$a^2 + b^2 = c^{16}$
and
$a^{16} + b^2 = c^2$
each have an infinite number of solutions with a, b, and c nonzero integers.

The following, by William J. Deane, should be read carefully, as his usage of "n's place" is not standard:

37 What is the smallest number (N) of n digits, which, when removing the digit from the units place and relocating it in front of the n's place, exactly doubles the number. For example, try the number 1,052. Relocating the 2 from the units place gives 2,105. This trial does not quite satisfy the conditions of the problem because 1,052 doubled is 2,104 $\neq$ 2,105.

A bridge problem from Paul D. Berger:

38 With bidding and lead as shown, how do you play the following hand to maximize the probability of making the contract?

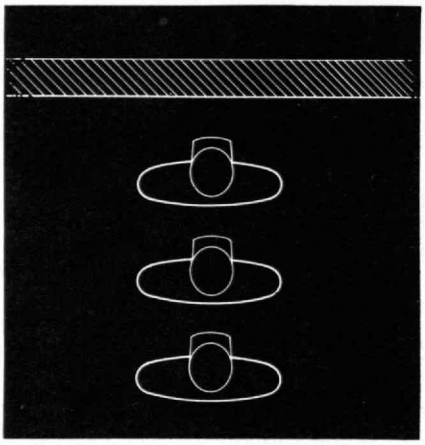
North:	**South:**
♠ A Q J 8 5	♠ K 10 9 6 3
♥ A K 7	♥ 5 4 3
♦ A 7 5	♦ 9 6 3
♣ K 3	♣ A 2

The bidding: West, four clubs; North, double; East, pass; South, four spades; West, North, and East, pass. West opens with the ♣Q!

Here's one David Dewan (the proposer) can't do; can you?

39 I want to send a record to a friend but don't want her to guess what's inside from the size and shape of the package. What's the smallest size *cubic* box that will hold a 12-in. record (without its jacket, of course)?

My friend John P. Rudy has a problem of current interest:



40 Three prisoners stand in a row, each facing the back of the one in front of him, the front one facing a wall perpendicular to the prisoners' line. The prisoners can neither turn around nor see their own heads. But they know that there are five hats, three red ones and two black ones; each prisoner is wearing a hat, and the remaining hats are hidden from view. If any prisoner can state the color of his own hat and provide sufficiently good reasons for his choice (law of averages excluded), he will be set free. After a suitable time, the prisoner nearest the wall announces his answer, is correct, and is set free. How?

Speed Department

The only contribution is from John E. Prussing:

SD21 Find the fallacy in the following proof that 2 = 1:
$x^2 = x \cdot x = \underbrace{x + x + \ldots + x}_{x \text{ terms}}$.
Differentiating:
$2x = d/dx\,(x + x + \ldots + x)$
$= \underbrace{1 + 1 + \ldots + 1}_{x \text{ terms}} = x$
Thus for $x \neq 0$, $2 = 1$.

Solutions

21 Define two functions, f and g recursively by

$$f(n, a) = \begin{cases} a \\ 1 - \log f(n-1, a) \end{cases}$$

$$g(n, a) = \begin{cases} 1/a \\ g(n-1, a)/f(n, a) \end{cases}$$

in each case if $n = 0$ and $n > 0$.
Then determine whether either of the following converge:

$$\sum_{n=1}^{\infty} g(n, n)$$

$$\sum_{n=1}^{\infty} g(n, 2)$$

Only Mr. Prussing is Johnny-on-the-spot:
$\sum_{n=1}^{\infty} g(n, n)$ does not converge. This can be shown by examining the ratio
$g(n, n)/g(n-1, n-1) = 1/f(n, n) = 1/[1 - 1n\, f(n-1, n)]$.
This ratio of successive terms in the series is unity (since $f(0, 1) = 1$, $f(n-1, n) = 1$ for any n). In fact, every term in the series is infinite, since $g(0, 0) = \infty$. The second series, $\sum_{n=1}^{\infty} g(n, 2)$, is not even defined for real-valued functions. This is due to the fact that real-valued members of the sequence f (n, 2) do not exist for $n > 7$, due to the fact that $f(7, 2) < 0$.

22 Find the smallest integers m and n such that $m - n^3$, m, and $m + n^3$ are all perfect squares, and give a general solution showing infinitude.

The following is by R. Robinson Rowe, an M.I.T. alumnus ('18) who formerly

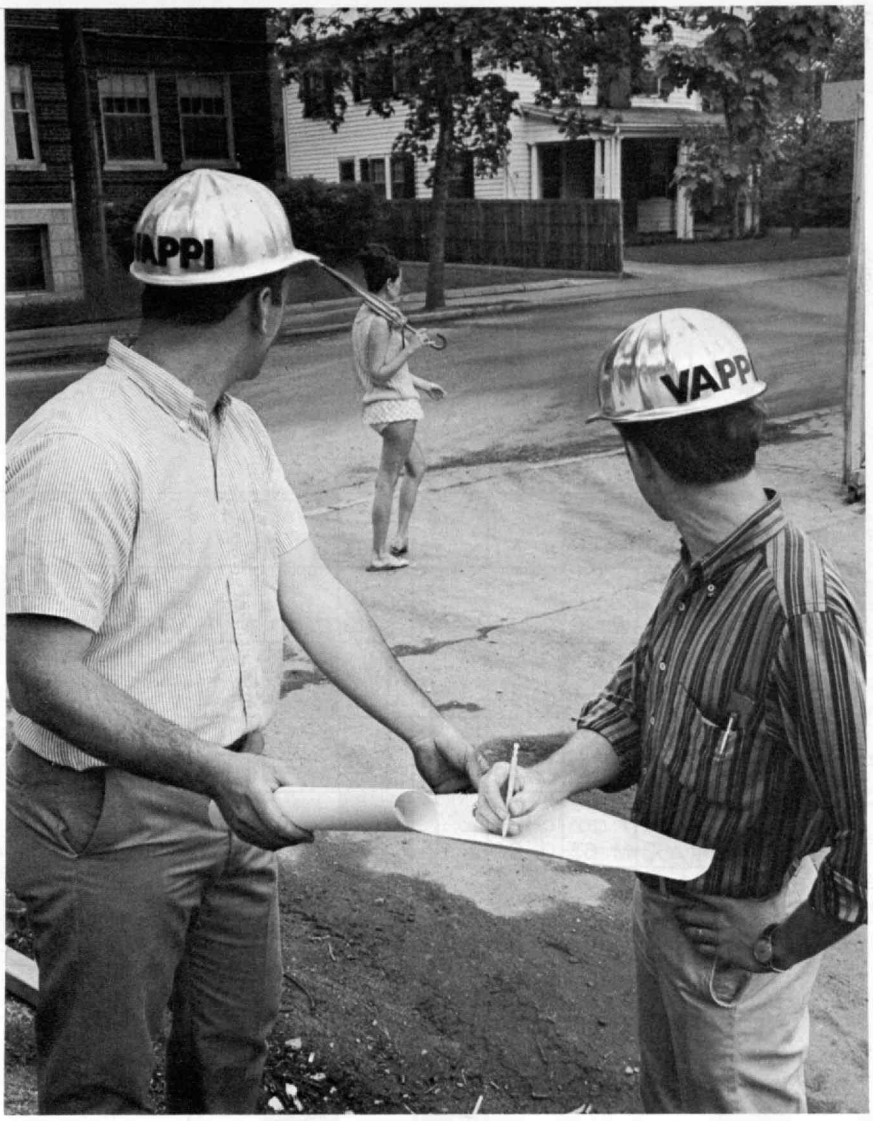
conducted a column not unlike this one for *Civil Engineering* magazine:
The squares $(a^2 - 2ab - b^2)^2$, $(a^2 + b^2)^2$, and $(a^2 + 2ab - b^2)^2$ are in arithmetic progression with differences of $4ab\,(a - b)\,(a + b)$. Multiplication of each of the three squares by a fourth square will generate an analogous set with differences also multiplied by the fourth square. We may choose this fourth square so as to make the differences the required cube n^3. First factor the difference
$4ab\,(a - b)\,(a + b) = rs^2t^3$
in which r, s, and t may be unity, prime, or composite. Then choose for the fourth square r^2s^4, making
$m = r^2s^4\,(a^2 + b^2)^2$ and $n = rs^2t$.
Any pair of integers a and b will generate a primitive solution; hence an infinitude may be determined. For the least solution,
$a = 2$, $b = 1$, $rs^2t^3 = 24 = 3 \times 1^2 \times 2^3$,
$r = 3$, $s = 1$, $t = 2$, $r^2s^4 = 9$, $n = 6$,
$m = 225$,
and the squares are $225 - 216 = 9$, 225, and $225 + 216 = 441$.

Also solved by Winslow H. Hartford.

23 The following pertains to a boat and crew cruising the Lesser Antilles:

We blew this one, as the contributor, Lawrence S. Kalman, points out: he writes to add a clue ("somewhat useful though possibly not essential") which we failed to publish: the puzzle was concocted some years ago. He also notes an error; number 7 across should read, "Miles logged in nine days *minus* 1 down." And he challenges you: "I hope you will give your readers another chance at solving the puzzle with this additional information." His request is hereby granted; fire away.

Allan J. Gottlieb, who studied mathematics at M.I.T. in the Class of 1967, is a teaching assistant at Brandeis University. Send problems and answers to him at the Department of Mathematics, Brandeis University, Waltham, Mass. 02154.



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Tech-Crostic
David L. and Judith G. Holt

A Prize Puzzle

				E 1	X 2	O 3	N 4	C 5	V 6	G 7	S 8		T 9	O 10	S 11	I 12	M 13
	X 14	F 15	W 16	R 17	K 18	I 19	C 20	A 21	S 22	E 23		J 24	Y 25	W 26		K 27	D 28
G 29	Q 30	U 31	P 32	C 33	L 34	A 35		T 36	V 37		P 38	B 39	K 40	J 41	F 42	I 43	X 44
	F 45	Q 46	N 47	A 48	U 49	E 50	J 51	C 52		O 53	B 54	F 55	I 56	P 57	K 58	G 59	X 60
M 61		V 62	M 63	O 64	J 65		S 66		Q 67	G 68	B 69	W 70	I 71	C 72	F 73	D 74	H 75
T 76	A 77	L 78	O 79		V 80	T 81		J 82	Y 83	T 84		M 85	A 86	V 87	P 88	L 89	N 90
C 91	H 92	F 93	J 94	D 95	R 96	U 97		D 98	K 99	Q 100	O 101	H 102	W 103	R 104	J 105	U 106	S 107
G 108		M 109	P 110	S 111	Y 112	B 113	G 114	J 115		L 116	A 117	S 118	K 119	C 120	U 121	B 122	Q 123
J 124		R 125	S 126	L 127		U 128		C 129	Y 130	U 131	G 132	I 133	E 134		W 135	N 136	
G 137	K 138	J 139	A 140	F 141	E 142	I 143	C 144		N 145	W 146	S 147		M 148	L 149	T 150	A 151	K 152
Q 153	R 154	B 155	J 156		H 157	M 158	C 159	Q 160	L 161	V 162	A 163	D 164	J 165				

Use the definitions at the right to help define the words to which they refer; then enter the appropriate letters in the diagram to complete a quotation from a scientific work. The first letters of the defined words give the author and title from which the quotation is taken. Black squares in the diagram indicate the ends of words; when there is no black square at the right end of the diagram, the word continues on the next line.

The correct solution to this Tech-Crostic will appear in the July/August issue of *Technology Review.*

David L. Holt is Assistant Professor of Metallurgy at M.I.T. He will welcome readers' comments; address him in care of *Technology Review,* Room E19-430, M.I.T., Cambridge, Mass. 02139.

A. A mirror mounted on an axis moved by clockwork, by which a sunbeam is steadily reflected to one spot. — — — — — — — — —
86 35 163 77 151 48 21 117 140

B. An enzyme that coagulates milk. — — — — — —
54 113 69 39 122 155

C. Followed by Word H, act done for applause. — — — — — — — — —
144 159 20 52 72 129 5 120 33
—
91

D. Quill or flight feather. — — — — —
74 98 95 164 28

E. A compound of the bivalent group NH, with bivalent acid radical. — — — — —
142 134 50 23 1

F. Transition area between two adjacent communities, such as forest and grassland. — — — — — — —
73 42 15 141 55 93 45

G. Two basic complementary tribal subdivisions; halves. — — — — — — — — — 108 68 7 137 132 29 114 59

H. See Word C. — — — — 157 102 75 92

I. Authority; freedom. — — — — — — — 19 71 56 43 143 12 133

J. One hundred-millionth of a centimeter (2 words). — — — — — — — — — 94 124 156 165 24 105 51 65 41 — — — 115 139 82

K. Wriggled. — — — — — — — — 58 99 18 119 152 138 27 40

L. Diseased. — — — — — — 89 78 116 149 161 127

M. Used without reference to a thing or things; ideal. — — — — — — — — 148 109 61 13 63 158 34 85

N. Capital of Bulgaria. — — — — — 4 90 136 47 145

O. Smallest of a train of gear wheels. — — — — — — 53 10 79 101 64 3

P. Weird; uncanny. — — — — — 57 110 88 38 32

Q. Obscured by nearness to the sun. — — — — — — — 67 123 46 153 100 30 160

R. Leg bone. — — — — — 17 96 104 154 125

S. Superfluous; excessive. — — — — — — — — — 11 22 118 107 8 147 66 126 111

T. Conductor leading from a main (elec.); counterbalance; compensate. — — — — — — 36 9 81 150 84 76

U. In mechanics, study of the equilibrium of forces. — — — — — — — 49 121 128 31 106 97 131

V. Drink made from the seeds, roasted and ground, of a shrub or small tree of the madder family. — — — — — — 162 80 37 62 87 6

W. Organic basis of bone tissue. — — — — — — 135 16 70 26 103 146

X. Variegated. — — — — 14 2 60 44

Y. Tetragrammaton. — — — — 130 83 112 25

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Of Culture, Sulfur, and Medicine

Global View of Britain

To the Editor:
I read the article of Peter Medawar (*Technology Review,* December, 1969) with interest. Despite its undoubted learning, it shows a lack of cultural and historical self-criticism—by which I mean a critical and skeptical attitude towards one's own cultural history.

Specifically, I have come to suspect that Great Britain has grown up as a colonial culture—not a genuinely indigenous one. Technological values predominate in such a society. There are few native cultural roots to which technology (and other imported and importable skills) can be grafted. These skills become the native elements of the culture (the "workshop of the world" sort of thing). The society will tend to be parasitic (imperialistic) or obsequious (vis-à-vis the U.S.A.).

A more global perspective is required to put the achievements and failings of technological societies (and of technology) into meaningful relationship with other societies and other values and skills.

Surindar Suri
Friends World College
Westbury, New York

On Increasing Our Efficiency

To the Editor:
In the January, 1970, *Technology Review,* Professor Thomas K. Sherwood asks "Must We Breathe Sulfur Oxides?" and Professor James A. Fay writes of oil spills; Both authors ignore the possibility of reducing exposure by more efficient use of fossil fuels.

In contemporary steam plants about three-quarters of the fuel energy introduced into the system is discharged to the environment as heated stack gas or condensor coolant. I call your attention to a proposal of the Sarasota Research and Development Corp., suggesting that the amount of fuel required to produce a given amount of electric energy could be halved by substitution of a low boiling point gas cycle for the present condensor in steam systems.

It seems to me that the best way to stop pollution is to reduce waste, since this also reduces the drain on world natural resources. The second best, but also necessary method is to detoxify emissions.

Kenneth M. Turner
Sacramento, California

Paranoia or Protection

To the Editor:
The April, 1970, issue of *Technology Review,* devoted to the interaction of technology and medicine, was stimulating in its illumination of the shape of this interaction.

I am a graduate chemical engineer who after several years in the chemical industry joined this hospital/medical school complex to devote myself to biomaterials problems. As a result of these activities over the past five years, several points came to mind which may be of additional interest to readers.

The section "An Engineer in the House" in Samuel Moffat's article touches on key issues. Unless an engineer comes to live with physicians in their place of business, he will tend to develop elegant solutions to rather irrelevant problems. This derives from the physicians' difficulty in problem posing for the engineer. In many cases, they are not sufficiently aware of available technology to formulate appropriate questions. The engineer must listen and also look for himself, lest he be unintentionally misled. Moreover, the living in experience helps bridge the discipline gap by building mutual confidence between the engineer and physician.

In this connection, I believe a bioengineer must bring first-class engineering background to the clinical setting in order to function effectively. It would not be desirable to develop hybrid curricula if such training did not give adequate depth to either the life or physical science aspect. My own experience is that an inquisitive physical scientist can develop a basis in life science quite adequate for interdisciplinary interaction.

Having emphasized the above approach for interdisciplinary efficacy, I should point out serious impediments to its success. Second-class citizenship may become apparent to the engineer since his discipline lacks historical status in the medical community. The engineering approach may be viewed all too often as a threat to the sinecures of some member of the medical establishment. Obstacles to publication in clinical journals may become evident. And finally, but by no means least important, financial reward is unbalanced compared to his medical colleagues.

Another most important need for improving the impact of technology on medicine is for transfer of industrial information and techniques to the medical center. The industry with which I had been associated has generally been paranoid on the matter of assisting the physician. This paranoia has mainly been based with considerable justification on the possibility of legal liability for real or imagined clinical failure. It is imperative that a workable solution to adequately protect industry be provided by the Congress. A key to such protection may be effective monitoring of clinical protocol by special committees derived from the university/medical center, the Department of Health, Education and Welfare, and the Bureau of Standards. A uniform, expeditious and unbiased review mechanism needs to be established.

Charles A. Homsy
Houston, Texas

The writer, who graduated from M.I.T. in chemical engineering in 1953, is Director of the Prosthesis Research Laboratory, Fondren Orthopedic Center, Texas Medical Center, Houston, and Research Assistant Professor in Orthopedics at Baylor University College of Medicine.—Ed.

May Tech-Crostic Solution

Most of the time I was prying sea-urchins from the limestone with my feet in the black silt of the Nile. The gamooses and camels and especially the fellahin stared at me, of course, wide-eyed, and a worthy Arab, thinking that I was digging for "antiques," asked to see my research permit.
—P. (ierre) T. (eilhard) DeChardin, *Letters from Egypt.*

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TR-370

Institute Review

General Motors, M.I.T., and Social Responsibility

The Executive Committee of the M.I.T. Corporation, modifying recommendations of M.I.T.'s student-led "Campaign G.M." and a task force of the M.I.T. General Assembly as well as one recommendation of the Corporation's own Joint Advisory Committee (C.J.A.C.), voted all of M.I.T.'s 290,236 shares with the management of General Motors Corp. and against the proposals of the Project on Corporate Responsibility, Inc., at G.M.'s annual meeting on May 21.

But the Executive Committee insisted that it "shares the concerns which are felt in our community about the degradation of our environment and about the slow progress which we have made in dealing with problems of highway safety, mass transportation, and increasing opportunities for minority groups." Its vote was determined by the technicalities of the proxy situation, not by opposition to the goals of the student and Corporation advisory groups, said James R. Killian, Jr., '26, Chairman of the Corporation.

And, calling attention of the General Motors management to the C.J.A.C. and General Assembly reports, the Executive Committee asked that the management "recognize its obligation to act forcefully on the issues raised . . . and that it do what is necessary in the domains of management, research, and production to demonstrate its responsiveness to the public concerns in these reports."

The controversy was thus made more a matter of method than principle.

The point of sharpest controversy was the fifth proposal before the annual meeting of General Motors' stockholders: to add three members to the Board of Directors, it being understood that these three members would represent "public" as distinct from "corporate" interests. In its final decision—which the Executive Committee admitted was made by an "extremely narrow margin" of votes with James R. Killian, Jr., '26, Chairman of the Corporation (who is also a member of the General Motors Board of Directors), not participating—the Executive Committee said that, while "representation of [consumer, minority, and ecology interests] is very important, it feels that these special concerns should not be the sole responsibility of any one member of a corporate board." The Executive Committee, said its report, "could not come to agreement that the designation of a specific number of board members, such as 26, would be superior to the present number of 23, or to any other number."

In its support of the fifth proposal, C.J.A.C.'s majority wrote that "a willingness, indeed an enthusiasm, to include [segments of society that heretofore have had no real inclusion] will . . . bring new and imaginative viewpoints into its management."

The Executive Committee and its C.J.A.C. advisory group agreed on voting M.I.T.'s shares with management and against proposal 4, thus opposing creation of a G.M. shareholders' Committee for Corporate Responsibility. C.J.A.C. told the Executive Committee that General Motors needed "a committee to aid and advise them in all areas that relate to G.M.'s position in society." But, its report said, we have "serious reservations" about the method of selection and operation of the committee specified in the annual meeting proposal. Instead, C.J.A.C. and the Executive Committee joined in recommending to General Motors that such an advisory committee be in fact appointed by the G.M. management, its membership of eight to include a maximum of two G.M. employees and directors.

C.J.A.C. Dissenting Opinions

Three members of C.J.A.C. dissented from the majority report to the Corporation. Marshall B. Dalton, '15, wrote that though he had heard "highly emotional broad accusations of irresponsibility, . . . I find no solid factual base for the allegations made." Philip H. Peters, '37, admitted that "there appears to be legitimate question whether (G.M.'s) past and current efforts have been and are broadly enough based and aggressively enough prosecuted to meet its corporate leadership responsibilities"; but on proposal 5 he took essentially the position of the Corporation Executive Committee.

James S. Wiley, '73, said the C.J.A.C. report dealt inadequately with the broad range of issues which had originally been raised by the Project on Corporate Responsibility, most of which had been denied representation on the proxy for the G.M. annual meeting. The C.J.A.C. recommendation, he said, "lacks the force to persuade General Motors to improve its general policies toward the public" which was the goal of Mr. Wiley's constituency, the Undergraduate General Assembly, and its task force.

At a press conference following the announcement of M.I.T.'s position on its G.M. shares, Steven C. Carhart, '70, speaking for a student group known as "M.I.T. Campaign G.M.," criticized the decision. "The sad irony of this sort of thinking," said Mr. Carhart's statement, "is that its final result will be a General Motors board without ecologists, civil rights leaders, or consumer advocates. . . ."

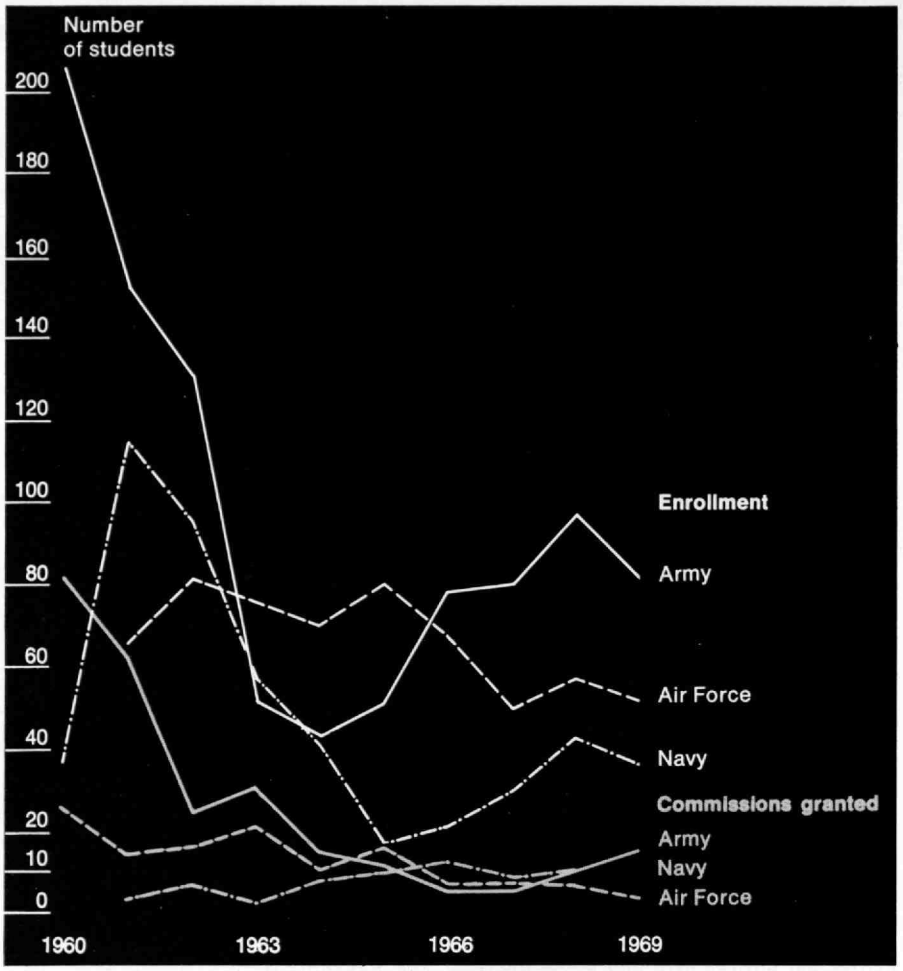
"We had hoped to help make General Motors socially responsible," said Mr. Carhart. "It now appears that we will have to begin closer to home, with a campaign to make the M.I.T. Corporation responsible to its alleged constituency and the long-term best interests of the Institute and the country."

Interruption and Contempt

Peter G. Bohmer, '65, and George N. Katsiaficas, '70, appealing their one-month sentences for M.I.T. classroom interruptions rendered by the Third District Court of Eastern Middlesex in April (*see* Technology Review *for May, p. 94),* were each sentenced in Lowell (Mass.) Superior Court on May 20 to pay fines of $50 and to spend two months in the Middlesex County House of Correction for the same offenses. And Mrs. Chrysoula Katsiaficas, following an emotional outburst in behalf of her son at the time of his sentencing, was herself sentenced to 10 days in Boston's Charles Street Jail in contempt of court by Judge George Johnson.

The original classroom interruptions of which Messrs. Bohmer and Katsiaficas were charged occurred on January 16, while other students and nonstudents were occupying the offices of the President of M.I.T. Both appeared in classes

Though their numbers are declining, some 175 M.I.T. students earn commissions in the Air Force, Army, and Navy each year through R.O.T.C., Professor Frederick J. McGarry told the faculty this spring; "it is obviously a desirable resource to have available," he said, citing statistics that 85 per cent of the Army's junior officers and 30 per cent of its general officers are R.O.T.C.-trained.



being conducted by John Wulff, Professor of Metallurgy, Emeritus, and Dr. Edwin D. Bransome, Jr., Associate Professor of Endocrinology and Metabolism, each received one-month sentences, to be served consecutively, for each classroom disruption. The jury returned its verdict after 90 minutes' deliberation.

A heavy police guard contributed to tenseness in the Lowell court, though there were few spectators and no interruptions. Both defending and prosecuting attorneys appealed for leniency for Mrs. Katsiaficas, but Judge Johnson insisted that her outburst could have inflamed the spectators in the court and that she in some sense shared blame for the fact that her son "had grown up with an utter disregard for law and order. Where have you been in the last four or five years?" he asked her.

The Award of Life

The Atomic Energy Commission came to M.I.T. on May 19 to present its citation and medal to Charles D. Coryell, Professor of Chemistry, for his contributions to the U.S. atomic energy program fission products research and radiation chemistry, for his "outstanding research" leading to the identification of promethium, for his "sound judgment and guidance as a consultant," and for his "continuing service to research and education" at M.I.T.

The presentation was made by Glenn T. Seaborg, Chairman of the A.E.C., who was accompanied by Theos J. Thompson, formerly a member of the M.I.T. faculty in nuclear engineering who is now an A.E.C. Commissioner.

In response, Dr. Coryell recalled his years with the Manhattan Project, when he was "made an 'instant nuclear chemist' [and was] in a highly excited state for a long time." Later he was instrumental in organizing a nuclear chemistry program at M.I.T. from which since 1946 at least 60 doctorates have been awarded. But, said Dr. Coryell, he owes a still more personal debt to nuclear chemistry: a victim of cancer, he told the award ceremony audience in McCormick Hall, nuclear materials "have given quite an extension to my life expectancy."

R.O.T.C.: Five Changes and a Reaffirmation

A faculty committee has proposed, and the M.I.T. faculty has approved, a series of five changes to be negotiated in the R.O.T.C. programs offered by Air Force, Army, and Navy at M.I.T. The proposals, which seem assured of approval by the three services, in turn assure the continuance of R.O.T.C. at the Institute.

The five changes, which stem from faculty action in May, 1969 (*see* Technology Review *for June, 1969, p. 84*), are designed to define reserve officer training activities as being separate from but consistent with the Institute's faculty-governed academic programs; they are:

1. The R.O.T.C. activities will no longer be organized into three separate academic departments; instead, there will be a single Office of R.O.T.C. Programs reporting directly to the Provost.
2. Subjects taught exclusively for R.O.T.C. students by members of the armed forces assigned to the Institute will not be given degree credit. (Most of the R.O.T.C. curricula consist of regular M.I.T. courses given by regular faculty, and credit is of course to be continued for this work.)
3. A special faculty committee, reporting annually to the Provost and the faculty, will guide and control future R.O.T.C. activities.
4. M.I.T. will intervene where necessary to assure that no R.O.T.C. student loses his opportunity to earn his M.I.T. degree because of a call to active duty. ("This has happened infrequently in the past," Frederick J. McGarry, '50, Professor of Civil Engineering who was Chairman of the committee, told the faculty; "we wish it not to occur in the future.")
5. The three R.O.T.C. unit commanders will be appointed as Visiting Professors at M.I.T., and other military personnel stationed at the Institute as instructors in the three programs, many of whom now enjoy faculty status, will be appointed as Technical Instructors.

All five changes, said Professor McGarry, seem both desirable and feasible. Faculty discussion centered on the faculty appointments as Visiting Professors for R.O.T.C. unit commanders who are assigned by the military services and whose appointments are therefore reviewed—but not initiated—by the Institute. But faculty status for the unit commanders is at present a federal requirement.

Anticipating faculty debate, Professor McGarry asked rhetorically what effect the Cambodian invasion should have upon the faculty's R.O.T.C. decision; and he answered the question by quoting a recent *The Tech* editorial: "President Nixon's excesses in Southeast Asia add no qualitatively new factors (in the debate about R.O.T.C. on the campus). . . . M.I.T. must not forego the intrinsic value

G. Kepes

S. E. Luria

of R.O.T.C. for some ineffective, symbolic protest." David H. Frisch, Ph.D. '47, Professor of Physics, agreed by noting, "I hope the generals at the S.A.L.T. (Strategic Arms Limitation Talks) talks have an R.O.T.C. education—and at M.I.T.!"

In addition to Professors McGarry and Frisch, members of the R.O.T.C. Study Committee, whose report was accepted by a faculty vote of nearly three to one, were James M. Austin, Sc.D. '41, Professor of Meteorology; Richard M. Douglas, Head of the Department of Humanities (who told the faculty during the May 26 meeting that because of new developments in Southeast Asia he wished to disassociate himself from the report and to eliminate military training from the campus); Henry A. Millon, Associate Professor of the History of Architecture; Edward B. Roberts, '57, Associate Professor of Management; and Warren M. Rohsenow, Professor of Mechanical Engineering.

The Armstrong Award

A 1969 Major Armstrong Award—the "Oscar" of FM radio—has been given to WTBS, M.I.T.'s student-operated campus radio, for its 60-minute documentary program on the "November Actions," the militant anti-war demonstrations at the Institute in November, 1969.

WTBS was on the air almost continuously during the November 4 to 6 period, broadcasting from its studio in the Walker Memorial Building and, by telephone and transcription, from the scenes of action. At the end of the actions the station assembled and broadcast an hour-long summary, and it was this program—rich in actualities—that was judged best in the noncommercial division in the annual Armstrong competition.

The Armstrong Awards are administered by Columbia University and include recognition for all types of outstanding programming by FM stations, commercial as well as noncommerical. WTBS' award—$500 and a bronze plaque—was presented in Chicago on April 4 at the meeting of the National Association of FM Broadcasters.

Unmanned Research on Mars

Five members of the M.I.T. faculty are among the expert advisers selected by the National Aeronautics and Space Administration to help design experiments to be landed on Mars in 1973—or whenever funds finally permit the project to be completed.

Klaus Biemann, Professor of Chemistry, is one of eight scientists who will help design an experiment to analyze atmospheric and surface materials in relation to living things. Alexander Rich, Professor of Biophysics, will work with six scientists on "active biology," to determine if living things are in fact present on Mars. Frank Press, Head of the Department of Earth and Planetary Sciences, and Mahmet N. Toksoz, Associate Professor of Geophysics, will together work on a seismology experiment. And Irwin I. Shapiro, Professor of Geophysics and Physics, will work with six other scientists on radio systems to probe the Martian atmosphere and detect motions of the planet.

Management for Government

Fourteen government officials—13 from U.S. agencies and one from Massachusetts—are completing a one-year study of modern techniques and applications of systematic analysis in management, budget control, and program planning at M.I.T. They are members of a program for mid-career government officials cosponsored by the M.I.T. Center for Advanced Engineering Study and the Department of Political Science.

Similar programs are conducted at five other universities—Princeton, Harvard, California (Irvine), Maryland, and Stanford—all under a general government effort to encourage modern management techniques in federal and state agencies.

Special studies for the group at M.I.T. are built around a core of instruction in systems analysis, planned program budgeting, cost-effectiveness analysis, and systematic policy analysis. Many of the M.I.T. group are also enrolled in a special Center for Advanced Engineering Study course in fundamental computer operations and programming.

M.I.T. participants include three each from the Departments of State and Army and one each from the Food and Drug Administration, National Institutes of Health, Federal Aviation Administration, Defense Supply Agency, Peace Corps, Veterans Administration, Agency for International Development, and Massachusetts Department of Education.

Institute Professorships to an Artist and a Biologist

Gyorgy Kepes, Professor of Visual Design, and Dr. Salvador E. Luria, Sedgwick Professor of Biology, have been named to the distinguished rank of Institute Professor at M.I.T. Their appointments, recommended by a committee of eminent scholars following nomination by members of the faculty, were announced by President Howard W. Johnson following approval by the Academic Council and Corporation.

Professor Kepes, who has been at M.I.T. since 1946, directs the Center for Advanced Visual Studies; President Johnson said he "has been responsible more than any other individual for the flowering of the arts at M.I.T." Early in his years at the Institute Professor Kepes developed subjects in visual design for undergraduates and graduate students in architecture, and this work has more recently been extended to many other Institute undergraduates through the humanities program. Throughout his M.I.T. career—and earlier, during training in Europe and teaching at the Institute of Design in Chicago—Professor Kepes has focussed efforts on the convergence of science and the arts—how each can enrich the other.

Professor Luria shared the 1969 Nobel Prize for Medicine or Physiology for basic research on viruses which President Johnson said is "regarded as primarily responsible for modern advances in the control of viral diseases as well as advances in molecular biology." He has written many papers, has served as consulting editor for many journals, and is regarded as one of the most stimulating teachers in M.I.T.'s Department of Biology, where he has taught since 1959.

The Man Who Found "Solutions to Trouble in Paradise"

The $8 million Camille Edouard Dreyfus Chemistry Building has been completed, occupied, and dedicated at the Institute, and Howard W. Johnson, President of M.I.T., says it represents "a new commitment to the role of chemistry at M.I.T."

Speaking at the dedication luncheon on April 17, President Johnson reminded his audience that the opportunity for students "to work with the real material" was one of the Institute's basic precepts when chemistry was first taught at M.I.T. more than a century ago. Since then the Institute has been the originator of the field of physical chemistry, and the Chemistry Department has awarded M.I.T.'s first Ph.D. degree and the first degree ever given to a woman.

James R. Killian, Jr., '26, Chairman of the Corporation, said that the Dreyfus Building has been made possible by gifts to M.I.T. from over 40 foundations, individual donors, and corporations. At least 70 per cent of the total was contributed from private sources and 75 per cent of this from corporate sources, he said; but—in introducing William D. McElroy, Director of the National Science Foundation, who was principal speaker at the dedication (*see below*)—Dr. Killian noted that N.S.F. had made "a very major grant" toward the project. (Dr. McElroy later said the $2,946,700 was "the largest grant in the history of the Foundation's Graduate Science Facilities Program and that the building "represents an important addition to our basic research capabilities.") The Camille and Henry Dreyfus Foundation itself contributed $3 million in gifts and pledges to chemistry at M.I.T., including provision for establishment of the Camille Dreyfus Professorship in Chemistry.

In presenting the building, Charles C. Parlin, a trustee of the Dreyfus Foundation, recalled that Dr. Camille Dreyfus "was completely dedicated to chemistry and to young people. He was the kind of man who could find trouble in paradise and still find a solution," said Dr. Parlin.

Three memorial rooms are included in the building:

◇ The Captain John Baptiste Ford Memorial Graduate Reading Room, named for the founder of Wyandotte Chemicals Corporation. The company contributed $150,000 to make the room possible.

◇ The Arthur Clay Cope Memorial Seminar Room, named in honor of the former head of the Department of Chemistry, who died in 1966. The room is a memorial gift from his wife, Mrs. Harriet Cope of Boston.

◇ The James Flack Norris Memorial Room, the gift of the Northeastern Section of the American Chemical Society. A distinguished member of the M.I.T. faculty for many years, Professor Norris died in 1940. He was twice president of the American Chemical Society.

The four-story Dreyfus Building, of poured concrete, is situated in the McDermott Court, east of the Institute's main buildings. Designed by E. M. Pei ('40) and Partners, it houses chemistry headquarters and laboratories for graduate students and postdoctoral chemists working in organic, bioorganic, and biophysical chemistry. The laboratory areas of the building are divided into small bays, each with its own ventilation outlets and utilities such as nitrogen and vacuum lines, designed for use by two to four students.

The next stage in the Institute's continuing program for improvement of teaching and research in chemistry, said Dr. Killian at the luncheon, is rehabilitation of the undergraduate chemistry facilities in the main buildings; he pledged that this work will go forward very soon.

Joining Conscience and Curiosity

Quoting Vannevar Bush, '16, Honorary Chairman of the M.I.T. Corporation ("Knowledge for the sake of understanding, not merely to prevail . . . is the essence of our being."), William D. McElroy, Director of the National Science Foundation, pledged the government's continuing support of basic science as "our best assurance that the knowledge we need will be there when we want it" at M.I.T. on April 17.

And yet, said Dr. McElroy, "a feeling of control and confidence in our science-based society continues to elude us," as evidenced by "Earth Days" and other kinds of demonstrations. Thus, Dr. McElroy concluded, the U.S. needs a new kind of scientific base which joins basic research more directly to human needs.

Dr. McElroy, who spoke at ceremonies for the dedication of M.I.T.'s new Dreyfus Building (*see above*), tentatively suggested that problem-oriented national research centers may be the appropriate mechanism. Such centers, he said, could serve as information clearing houses, appraisers of national needs and deficiencies, assessors of new technology, sources of policy recommendations, and centers for systems approaches to problems.

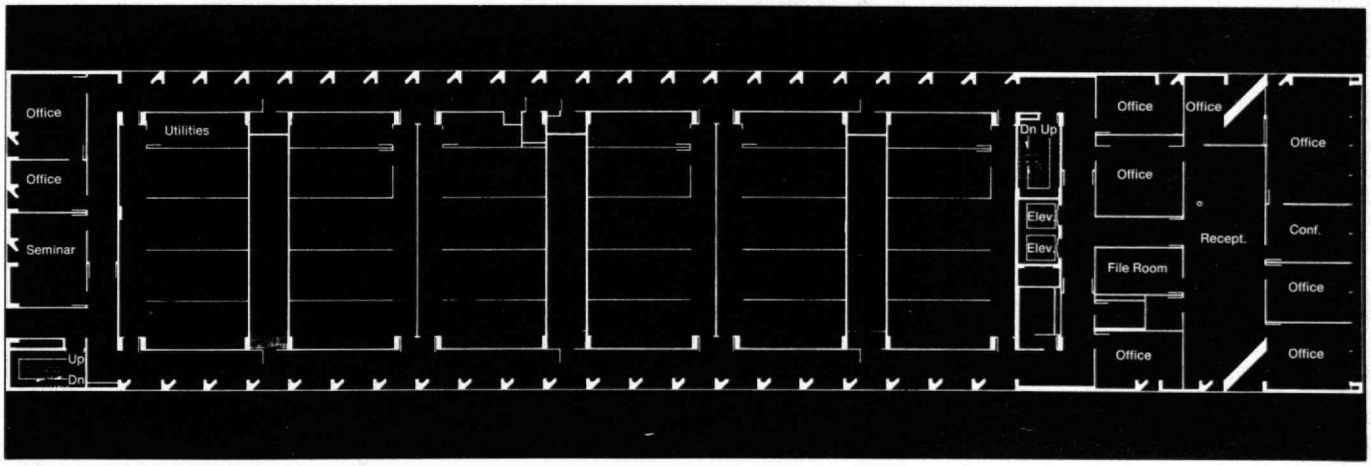
But he was at pains to reassure his academic audience that "I am not advocating a replacement of traditional forms of support for basic research." Instead, he said, "we are living in a period when our customary ways of doing science must be supplemented by additional problem-oriented intellectual and scientific inquiry." Thus, he said, we may "join conscience with curiosity."

A Turbine in a Library

A second car—a turbine-electric machine—is now being designed to compete for M.I.T. in the coast-to-coast intercollegiate Clean Air Car Race late next summer. Stimulated by a grant from General Motors Corp., which includes 20 new automobiles to contenders and $40,000 to the committee to aid in building vehicles and conducting the race, the transcontinental contest now may include as many as 40 low-pollution vehicles.

M.I.T.'s second car—the first is a modification of the electrically powered Corvair which first crossed the continent in the original electric car race in 1968—is now being designed by three members of the Class of 1970: Michael L. Bennett, George Negoro, and Stanley Bone. Their car, scheduled to be on the road in July, will combine a gas-turbine-driven generator with a large electric motor, and the students are now in the midst of de-

Three Nobel laureates in chemistry—Derek H. R. Barton of the University of London, Manfred Eigen of the Max-Planck-Institut, and Harold C. Urey of the University of California—came to M.I.T. on April 17 to celebrate the completion of the Camille Edouard Dreyfus Chemistry Building (below). They heard William D. McElroy, Director of the National Science Foundation (speaking, right), applaud basic science as "our best assurance that the knowledge we need will be there when we want it"; and they joined other dedication guests in touring the new building. Devoted chiefly to graduate chemistry research, the building has exterior corridors surrounding 24 laboratory areas, each shared by two graduate students, on each floor.



A. P. French

P. S. Eagleson

signing and building the rectifier and control units needed to couple their big machines.

Their motor—which weighs 1,000 lbs.—will generate a peak of 1,200 foot-pounds of torque and 600 horsepower. Mr. Bennett admits that this is oversize. But, he says, "we feel that everyone else has been using motors that are too small. We want a design that will absorb inefficiencies, meet the unexpected—something we can push hard if we need to," he says.

The turbine presents its own special set of problems; it will burn lead-free gasoline and at high operating temperatures will achieve very nearly complete combustion. The students are designing a heat-exchanger system based on freon gas to reduce the temperature of the exhaust gases so a system of water and catalytic filters can be used to reduce pollution.

Turbine noise presents another potential problem, but the designers are confident: "We have in mind a design for baffles and acoustical shielding that we think should make it possible for us to run the turbine inside a library and not disturb anyone's reading."

Associate Head of Physics

Anthony P. French, Professor of Physics, has been named Associate Head of the Department; he will take up responsibilities vacated by Albert G. Hill, Professor of Physics, who was Chairman of the Physics Council prior to his appointment as M.I.T. Vice-President for Research.

Professor French will continue his part-time association with the M.I.T. Education Research Center, in which he has been an active participant since coming to the Institute in 1964, and in his new post he will be a member of the M.I.T. Science Council.

In six years on the Institute faculty Professor French has achieved a special reputation as an undergraduate teacher, and he has been active on faculty committees planning curricula and programs. He first came to M.I.T. as a Visiting Professor from the University of North Carolina, where he was Head of the Department of Physics, in 1962; earlier he had been a member of the faculty at Cambridge University, England (from which he holds B.A. and Ph.D. degrees), most recently Director of Studies in Natural Sciences. Professor French first came to the U.S. in 1944 as a member of the British mission to the Manhattan Project at Los Alamos, N. Mex.

Engineering Appointments

Charles L. Miller, '51, Head of the Department of Civil Engineering until he became Director of the Charles Stark Draper Laboratory (formerly the Instrumentation Laboratory) on January 1, will now be Associate Dean of the M.I.T. School of Engineering.

He will be succeeded in the Civil Engineering Department by Peter S. Eagleson, Sc.D.'56, who has been a member of that Department since 1952, when he completed studies at Lehigh University.

Professor Miller will continue to head M.I.T.'s Urban Systems Laboratory, of which he has been Director since its founding in 1968. And Professor Charles S. Draper, '26, who headed the Instrumentation Laboratory for 30 years until 1970, continues as President of the newly-independent Draper Laboratory.

Raymond L. Bisplinghoff, Dean of the School of Engineering, noted in his announcement that Professor Miller has "a broad background and understanding of the complex areas of systems engineering and analysis—areas of increasingly urgent concern to all Departments within the School as they seek to deal with large-scale systems of all kinds." His academic appointment emphasizes the effort which will be made to integrate activities in the Urban Systems Laboratory more closely with teaching and research in the School of Engineering.

Professor Eagleson's fields of specialization are fluid dynamics and hydrology, and he has made special contributions to the dynamics of beach formation and shallow-water waves which have been "of great importance in understanding coastal processes," Dean Bisplinghoff said. Professor Eagleson became a member of the faculty at M.I.T. in 1955, while completing his studies in the Hydrodynamics Laboratory; he has been Professor of Civil Engineering since 1964.

Calculus and Probability: On-the-Job Self-Study

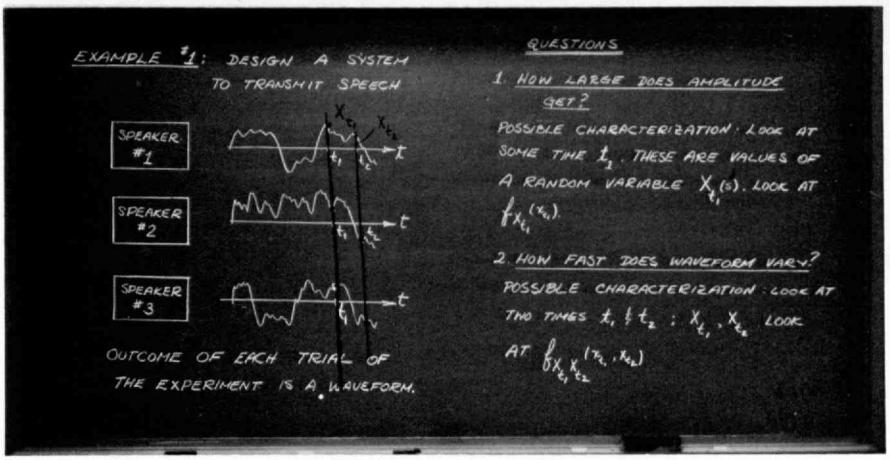
A three-year effort to develop a uniquely powerful series of self-study programs for practicing engineers is yielding its first fruit from the M.I.T. Center for Advanced Engineering Study. Two courses—"Calculus Revisited" and "Probability"—are ready for distribution, and three courses —"Calculus Revisited II," "Random Processes," and "Colloid and Surface Chemistry"—have been announced for 1971.

Each course includes a pre-test, a study guide, a series of lectures on film or videotape, a set of lecture notes—photographs of the lecturer's blackboard at the end of each lecture—, a first-rate textbook, and a set of problem and quiz solutions. A company wanting to provide the course for members of its engineering staff pays $7,800 for the lecture film or tape and $30 per set for the accompanying materials; individual sets can be rented for more modest amounts.

In a statement announcing availability of the first two courses, Harold S. Mickley, Sc.D.'46, C.A.E.S. Director, emphasized the flexibility of the self-study plan. Each course includes overview material suitable for senior executives and technical managers as well as the full content for practicing engineers, industrial scientists, and even technicians.

"At one extreme," he said, "these courses can be used by individuals, each of whom sets his own pace, interrupting his study when business or personal responsibilities interfere. At the other extreme, the system can be used in the form of regularly scheduled classroom sessions. Between these two extremes, almost any variation is possible."

The central focus of each C.A.E.S. self-study program is the lectures, according to Dr. Mickley, delivered before television cameras by outstandingly experienced teachers. The course in "Calculus Re-



The pre-test for the new self-study course in "Probability" now available from M.I.T.'s Center for Advanced Engineering Study includes this problem, and if you cannot deal with it you are a candidate, instead, for the C.A.E.S.' self-study of "Calculus Revisited." The accompanying discussion describes this problem as an example of a frequent case: the derivative is needed of a function defined as an integral. Below, lecture notes, part of the self-study course on "Probability" now being completed at the M.I.T. Center for Advanced Engineering Study, are provided by photographs of the lecturer's blackboards.

visited" includes 40 30-minute lectures by Herbert I. Gross, Senior Lecturer in Civil Engineering at M.I.T., who has been teaching the same material to members of the C.A.E.S.' residential Practicing Engineers Advanced Study Program for three years. "Probability" is the four-year outgrowth of a course developed for the same group by Wilbur B. Davenport, Jr., Sc.D.'50, Professor of Electrical Engineering at M.I.T., who is known in his field for writing "the modern classic on the application of random process theory to communication problems."

Dr. J. Th. G. Overbeek of the University of Utrecht has this spring completed the lectures to be released next year in the self-study on "Colloid and Surface Chemistry," and Dr. Gross is completing similar filming for "Calculus Revisited II." In addition, the Center is now preparing or considering for later release courses in "Calculus Revisited III," "Solid-State Circuit Design," "Fluid Mechanics," "Principles of Systems," and "Physics Revisited."

Teaching Math the New Way

In his introduction to "Calculus Revisited," Dr. Gross calls it "much more than a 'refresher' " course, "designed to review the first two years of college calculus and differential equations, . . . to help the professional engineer scrape some of the 'rust' off his mathematical 'tools' before embarking on a program of advanced-level study such as 'Probability and Random Processes.' " It includes new topics—set theory, modern algebra, etc.—but emphasizes a unified view of traditionally disparate subject areas. "Math isn't taught the way it used to be," says Dr. Gross, "and 'Calculus Revisited' reflects the change."

In describing the importance of the "Probability" course, Professor Davenport notes the "wide applicability of probability theory in almost every discipline," including such fields as systems analysis, random processes, decision theory, statistics, quality control, control research, cybernetics, and statistical mechanics. "The professional who lacks an understanding of probability is handicapped," says Professor Davenport; the self-study is planned to provide fundamental principles, calculational tools, and practice in their use.

It doesn't matter how many degrees he has; when you start out on your own, the man you want is the competitive, imaginative man with real ability, said I. Austin Kelly III, '26 (left), President of the National Employee Relations Institute, at a New York M.I.T. seminar on how to start your own business this spring. More than 30 speakers and panelists (including Gary L. Benton, '59 (right), Vice-President of Gregory Fossella Associates, Inc.) spent two days with more than 100 young alumni interested in inside "dope" about how to begin a new business.

How to Sell an Idea and Influence Financiers

Here are six maxims for young entrepreneurs among many words of wisdom on the pressures, problems, and satisfactions of going into business for yourself spoken at a seminar of the M.I.T. Alumni Center of New York early this spring:

1. "The most important decision you ever make are made on the sheer, blind courage."—I. Austin Kelly III, '26, President of the National Employee Relations Institute, Inc.

2. "The greatest word in business is net, not gross!"—Joseph Wenick, '21, management consultant.

3. "You have a map of the territory. But the financial man can change the territory, and the territory won't be the same in three years anyway. So don't insist on your map."—Patrich R. Liles, instructor in the Harvard Business School.

4. "The typical new-venture man rates his product too high—and its cost too low."—Alexander R. Lehmann, S.M.'68, of William E. Hill and Co.

5. "If you don't have a lawyer, you'll soon have a lawsuit."—Arthur C. Silverman, '60, attorney with Golenbock and Barell, New York.

6. "Nowadays when an engineer has been engineering for four years and hasn't started his own business, there's something wrong."—Kenneth H. Olsen, '50, President of Digital Equipment Corp.

Speakers emphasized the problems, not the glamour, of entrepreneurship. Stanley L. Amberg, '60, attorney with Davis, Howie, Faithfull and Hapgood of New York, warned that good legal advice invariably costs less than the expense of litigation and settlement if the fledgling company tries to get along without a lawyer and makes a mistake.

As far as their pension and reimbursement policies are concerned, there are three kinds of companies, said Mr. Kelly: those that never will do anything, those that look but never leap, and those that realize "it's only a question of time and the sooner the cheaper." A new company needs to understand that it has lots of different kinds of leverage to attract the talent it needs, he said.

When you start your own company, said Mr. Liles, concentrate on the fundamental issues—research, development, and finance—that no one else can do for you. Get experts to help with accounting, organization, legal questions, even technical expertise. But don't let these experts take the ultimate decision-making job away from you; don't sign anything without reading it. At the first stages of financing a new venture, you have nothing to sell but an idea. No one can sell that but the man who understands it.

The idea that "if the product is good enough, people will find it" is simply "dangerously wrong," said Gorden Canning of William E. Hill and Co. Indeed he said, marketing is the "key factor" in the success of a new venture, and research is a key factor in marketing. No market is homogeneous, he said, and the point of good market research is to identify the most promising segments.

When it comes to venture capital, said Raymond Frankel, '43, President of the Technological Investors Management Corp., "I like a company that looks like high technology but really is low technology; high technology has a way of running into snags." Many areas of "the ecology business" fits this pattern, he said. And no venture capitalist these days, he warned, will be interested in an enterprise that will be dependent upon the military market.

More than 100 young M.I.T. graduates gave up their weekend to attend the New York meeting at the Hotel McAlpin on March 21 and 22, the first of four scheduled around the U.S. this spring. Francis J. Berlandi, '62, of Teledyne Isotopes, Inc., and Lester Seigel, '60, of Unitec Enterprises, Inc., were Co-Chairmen of the New York Planning Committee.

Paul V. Cusick

F. W. Watriss, '41

G. P. Dinneen

Scheduling Independence and the "Princeton Plan"

The first major changes in the Institute's academic calendar since World War II emergencies have been approved by the M.I.T. faculty and will become effective in September, 1970, on a three-year trial basis.

The calendar is changed in three significant ways:

1. The fall term will open earlier—September 14 in 1970—and will be completed, including final examinations, before the Christmas vacation.

2. The month of January—from January 6 through 29 in 1971—will be devoted to an independent study period, planned "to provide a time for students to read and to study at a more leisurely pace than is possible during the regular semester," according to the Committee on Educational Policy report recommending the changes to the faculty.

3. The spring term will open—and end—one week earlier than heretofore, with final examinations completed during the last week of May in 1971.

The independent study period, which is made possible by slight reductions in the number of days in each regular term and in the time devoted to final examinations and reading period, is to be optional. Student activities and the nonacademic professional life of M.I.T. are envisaged to continue, says the C.E.P. report, and it anticipates that "many students will be involved in reading or research projects of their own choosing."

A month after enacting these broad calendar changes, the faculty made a further—temporary—change for 1970. Recognizing the national movement to permit students to take time before the November elections to work for the candidates of their choice, (the so-called "Princeton Plan") the faculty voted in May that M.I.T. will hold "no academic exercises" for one week—from October 23 to November 2, 1970—and that students who work longer may make up "any quiz or similar assignment" due between October 19 and 23 and November 2 and 6. The extra week will be made up by omitting holidays and changing the reading period during the fall term, so that the total number of class days remains unchanged.

Financial Management

A major realignment of responsibilities has led to five new appointments in the Institute's financial management:

◇ Paul V. Cusick, Comptroller of the Institute, has been named Vice-President for Business and Financial Relations.

◇ Frederic W. Watriss, '41, Assistant Treasurer, has been named Associate Treasurer with increased responsibilities for financial management.

◇ Stuart H. Cowen, Director of Fiscal Planning and Administrative Director of the Division of Sponsored Research, succeeds Mr. Cusick as Comptroller.

◇ George H. Dummer, Associate Director of the D.S.R., becomes its Administrative Director.

◇ Frank R. Stevens, '46, Associate Director of the D.S.R., becomes its Deputy Administrative Director and Director of Fiscal Planning for M.I.T.

In his new post, Mr. Cusick will be "the senior officer responsible for operating business policies and procedures, and he will have responsibility for the effectiveness of the administration of these affairs," according to President Howard W. Johnson's announcement. In addition, he will continue to serve as M.I.T.'s contracting officer, to establish purchasing and procurement procedures, and to conduct fiscal relations with government agencies supporting M.I.T. research.

To his duties as Assistant Treasurer, Mr. Watriss now adds financial responsibilities for staff and employee benefit programs; he will also serve as principal liaison officer with M.I.T.'s banks and supervise the management of Institute funds and their use in support of M.I.T. budgets, according to Joseph J. Snyder, '44, Vice-President and Treasurer.

Mr. Cusick first came to M.I.T. in 1944 as a member of the administrative staff of the Division of Sponsored Research, and later he served also with the Division of Defense Laboratories before an appointment as Assistant Treasurer in 1954; he was the Institute's first Comptroller when appointed to that post in 1957. He has served as Treasurer of Mitre Corporation, Educational Services, Inc., and the Institute for Defense Analyses. He is a Director of the Harvard Trust Co. and of Mico Instrument Co. and he serves on the Executive Committee of the National Association of University Business Officers.

Following his graduation from M.I.T. in the field of management, Mr. Watriss served as Research Associate in the Department of Aeronautics and Astronautics. He joined the staff of the Treasurer's Office in 1952 and in 1959 became—in addition to his other duties—Recording Secretary, a post which he will continue to hold. Mr. Watriss is a director of a number of companies.

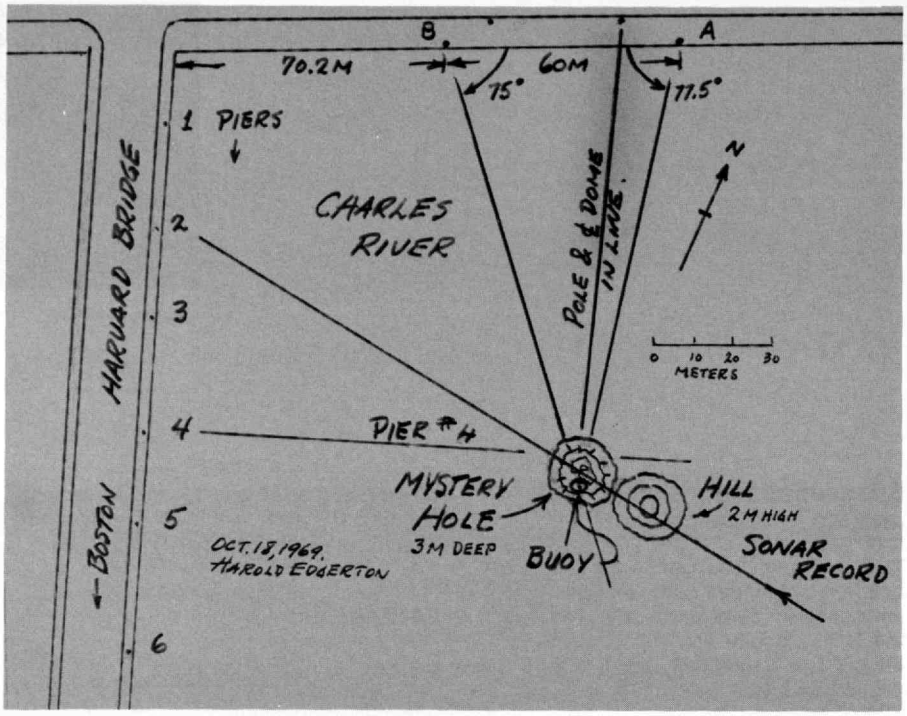
Lincoln Director

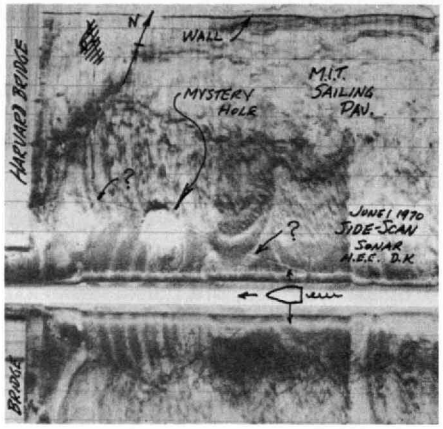
Gerald F. Dinneen, Associate Director, has been named Director of Lincoln Laboratory effective June 1 to succeed Milton U. Clauser, who has resigned to accept the position of Academic Dean at the U.S. Naval Postgraduate School in Monterey, California.

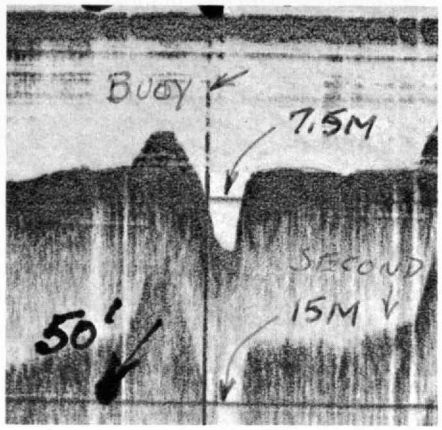
Since 1953, when he first came to Lincoln Laboratory, Dr. Dinneen has been a member of Lincoln's Data Transmission Group; in 1960 he became leader of that Group and Associate Head of the Information Processing Division, and three years later he was made Associate Head of the newly formed Communications Division.

"Under Dr. Dinneen's direction," said Howard W. Johnson, President of M.I.T., in announcing the new appointment, "the Laboratory will continue its important contribution to national defense programs, will seek to expand its efforts in such areas as health care, air traffic control and educational technology, and will vigorously pursue the development of new mechanisms which will improve the quality and quantity

Just 110 meters from the Harvard Bridge, due east from its fourth pier from the Cambridge side, is a hole 3 meters deep and about 10 meters across. Sonar studies by Harold E. Edgerton, Sc.D.'31, and his students (see below) prove it, and now the hole is charted and a buoy placed above it. But why would anyone dig it ?And when?







of interactions with campus educational and research activities."

A native of Elmhurst, N.Y., Dr. Dinneen studied mathematics at Queens College (B.S. 1947) and the University of Wisconsin (M.S. 1948, Ph.D. 1952). His scientific interests are in logical design and programming techniques for digital computers, satellite communications, and military systems design. Before coming to M.I.T. he was for two years at the Goodyear Aircraft Corp., studying applications of analog computers for real-time control systems.

Dr. Dinneen was named Assistant Director of Lincoln Laboratory in 1966 and Associate Director in 1968; he has served on numerous scientific advisory boards, task groups, and review boards—including the Committee on Undersea Warfare of the National Academy of Sciences.

In his announcement, President Johnson paid tribute to Dr. Clauser's "dedicated and effective leadership during a difficult period" at Lincoln Laboratory. Dr. Clauser came to the Lincoln Laboratory in 1966, when he also was named Professor of Aeronautical Engineering at M.I.T. He holds degrees from the California Institute of Technology and has had extensive experience in research and administration, including service as head of the School of Aeronautics at Purdue University.

Engineering Administration

John A. Currie, '57, who has been Assistant to the Vice President for Operations at M.I.T., has been named Assistant Dean of Engineering, Administration; he will assist Raymond L. Bisplinghoff, Dean of the School of Engineering, in the management of the School.

Mr. Currie has worked for United Engineers and Constructors, Philadelphia, and Cabot, Cabot and Forbes, Boston, in various management positions. He holds both S.B. and S.M. degrees from M.I.T. in civil engineering, and while a graduate student here he served as research assistant and Instructor in Civil Engineering.

Engineering Ingenuity

Three M.I.T. undergraduates have won $1,500 in the 1970 Luis de Florez Awards for "outstanding ingenuity" in designing engineering devices. The prizes: $1,000 to Richard B. Boyce, '71, for a direct-reading instrument to determine the area of a triangle; and $500 to Clifford C. Marr, '70, and Phillip J. Miller, '70, for new equipment to control a closed-circuit television reading aid originally designed by Philip J. Davis, '68.

Among other—unsuccessful—entries in the 1970 competition were an institutional trash compactor for apartment-house janitors, a "zing-ball" toy, a slide rule made compact by putting its scales on an endless mobius band, a lumped-parameter model of a vibrating human for use in measuring the response of humans to vibrations, an automatic stacker for the take-off of a corrugating machine in a corrugated-box works, and a tool for quantitative assessment of head room in the rear seats of automobiles.

Funds for the awards were given to the Institute by the late Luis de Florez ('11); they were administered this year by David G. Wilson, Associate Professor of Mechanical Engineering.

A Hole in the River

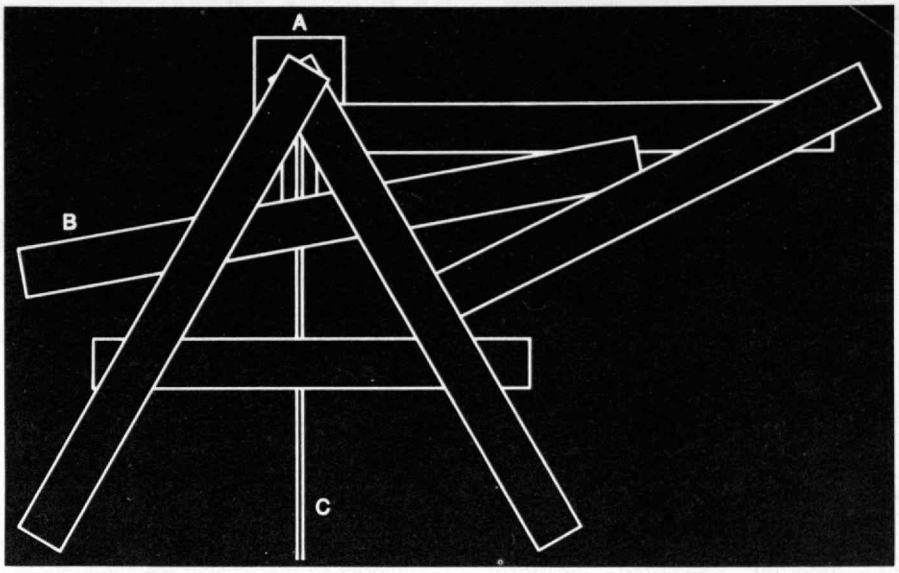
There's a hole nearly 10 feet deep and 30 feet across in over 20 feet of water in the middle of the Charles River opposite M.I.T. The mud excavated from it sits on the bottom next to the hole.

Why?

The question "bugs" Harold E. Edgerton, Sc.D.'31, Emeritus Professor of Electrical Measurements, and six of his graduate and undergraduate students—Andrew I. Fillat, John E. Huguenin, Don H. Johnson, John K. O'Neill, '73, James W. Sholer, '71, and George J. Varga, who used sonar equipment developed in Professor Edgerton's laboratory to find and map the hole.

For the first "real information" about the mystery, Professor Edgerton will award a copy of his book (with James R. Killian, Jr. '26), *Flash.* Write him at Room 4-405, M.I.T.

To replace the rope-and-bucket system for hauling water from irrigation wells in Togo, four M.I.T. mechanical engineering students have designed this A-frame pump system. A single man seated at A and operating the treadle at B provides 1/20 horsepower to the pump at the end of the cable C, sufficient to flow 5 gal./min. from a 10-ft. well, 1/2 gal./min. from a 100-ft. well.



Waiting in a 50-Foot Well

Through VITA, the M.I.T. Department of Mechanical Engineering last fall received a request from a Peace Corps volunteer in Togo: "We are digging wells by hand to a depth of 70 meters. Can you suggest a pump to pull water from them?" (Pump manufacturers could only suggest the old rope-and-bucket method, but the Peace Corps volunteer wanted something better.)

The problem was handed by David G. Wilson, Associate Professor of Mechanical Engineering, to four senior students in the Department's "experimental engineering" course, and their product—a "man-powered" pump made almost entirely of components which would be available in Togo as well as Cambridge, Mass.—is now on display.

Reporting on their work, the four students—O. David Asbell, Jr., James A. Bricker, Paul E. Guaraldi, and Thomas S. Stellinger—first describe the boundary conditions they put on the job: the pump must be man-powered, since no other source of sufficient energy would be so convenient or surely available; the man must use his legs, not his arms; the pump must be built of easy-to-get materials and simple parts; it must handle silty water (a requirement which eliminated closely fitting cylinders and pistons); it must be adaptable for wells ranging in depth from 20 to 100 feet; and it must be efficient enough so that one man working alone could steadily draw water from the well.

The students' design is a collection of wooden bars and levers and iron pipe, connected by hose and cable to a piston with a "rolling diaphragm"—chosen because it requires least accuracy and is therefore easiest to manufacture—submerged at the bottom of the well.

The students tested their pump by operating it between water barrels in the basement and on the second floor in the stairwell of M.I.T. Building 3; life near the President's office being what it is this winter, they admitted that their project "aroused considerable suspicion." Though there is a long list of improvements they would make before taking the pump to Africa, the students satisfied themselves that the basic concept was right.

"Compared to the conventional method of rope and bucket," says their report, "the man-powered pump is more than adequate in pumping rates and efficiency. . . . Produced in quantities of 10 or more, the materials for the pump should cost no more than about $50." But, they added, "we hope the Peace Corps volunteer isn't still waiting down in the well."

"Old-Fashioned Bull Sessions"

When alumni sit down with today's student generation for three hours, what do they talk about?

"They have very classic problems—against Vietnam, against defense work, saying the money should be used for pollution research," says William L. Maini, '51, after dinner with 15 students at Phi Sigma Kappa fraternity. But one important point, he adds: "Students feel that their education is too pure and therefore are reluctant to go out into the business world. They would like a laboratory of their own to 'putter about' in. Could the alumni do anything about this?"

William S. Grinker, '56, who spent three hours with 25 students at Sigma Chi, found them "very serious—career-oriented." But, he said, they "seem to have a distorted view of industry and environment."

These two reports were the first to come from what has been a continuing series of informal alumni-student meetings arranged in M.I.T. dormitories and fraternities this spring.

In another format, students and alumni have met informally following spring meetings of the Alumni Advisory Council in Cambridge; on March 30 they held what Max Selzer, '18, called "an old-fashioned bull session" with Charles L. Miller, '51, Director of M.I.T.'s Draper Laboratory. Mr. Selzer's report:

"The students probed particularly into Professor Miller's activities in respect to seeking projects in non-war-oriented research, work on such problems as transportation, pollution, and air traffic. They were convinced on the whole that a truly conscientious effort is being made by the Draper Laboratory in this direction."

Alumni contributed to the discussion, said Mr. Selzer, the notion that in these fields—in contrast to inertial guidance, where the Laboratory has a pioneering role—the Draper Laboratory "would be in direct and severe competition with industry and other research laboratories," and the students quickly saw that this "adds a new dimension to the M.I.T. problem."

Alumni Appointments

Two new assignments in the administrative staff of the M.I.T. Alumni Association have been announced by Donald P. Severance, '38, Executive Vice President: Doris S. Evans, to be Director of Alumni Records, and Helen M. Clifford, to be Assistant to the Treasurer.

Mrs. Evans has been at M.I.T. since 1957, and she has been Office Manager for the Alumni Association since 1963. In seven years since then, Mr. Severance said, a new data processing system has been established to deal with alumni records, and there have developed new demands for various special projects and new circulation for M.I.T.'s magazine, *Technology Review,* to add to her responsibilities.

Miss Clifford came to M.I.T. in 1963 following extensive business experience; she is responsible for accounting operations and has played a major role in the installation of new accounting systems and financial reporting, Mr. Severance said.

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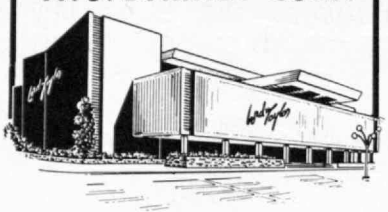

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This plan for collecting fares under a zone system was devised last fall by undergraduate students of David G. Wilson, Associate Professor of Mechanical Engineering, in the Engineering Projects Laboratory. They spent the first term building the devices which would do the job; and by the middle of January the hardware was installed in a chartered bus of the Massachusetts Bay Transit Authority so that invited members of the M.I.T. community could help them test it.

The students are persuasive: the plan makes possible zone fare systems so that short-distance riders pay no more than their share; the driver has no responsibility for collecting and handling money; and the money itself is handled automatically by a machine that can be made as theft-proof as need requires. The test revealed no serious problems. Where the fare-collection plan goes from here, says Professor Wilson, may be less important than the plans of its students—who have a developed interest in urban transportation and some engineering skills to back it up.

Deceased

Stuart A. Courtis, '99, October 16, 1969
Charles A. Newhall, '00, April 1, 1970
Arthur L. Derby, '03, August 23, 1961
Mrs. George H. Hamilton, '03, May 15
Lawrence H. Lee, '03, May 15
Mary N. Phillips, '03, May 15
George E. Sibbett, '03, May 30, 1969
Daniel F. Comstock, '04, March 2*
Carlton E. Atwood, '05, April 21
James S. Brown, '05, March 16, 1969
Herman T. Gammons, '05, April 1
Frank A. Benham, '06, September 2, 1968
Oscar S. Pulman, '06, October 5, 1968
Nahum C. Willey, '06, December 9, 1969*
Howard Marvin, '07, January 26
Chesney H. Criswell, '08, February 12
Edward O. Scriven, '10, April 7
Karl B. Kilborn, '11, December 21, 1969
Victor P. Klapacs, '11, July 3, 1969
Charles A. Cary, '12, January 22
Page Golsan, '12, March 2*
Charles W. Rieser, '13, February 10
Henry F. Merrill, '14, November 24, 1969
Arthur F. Petts, '14, October 29, 1969*
Harold B. Richmond, '14, May 7
Bowman S. Atkins, '15, January 22
M. Eben Hill, '15, April 15, 1967
Douglas H. McMurtrie, '15, March 27
George R. Urquhart, '15, March 17
Herbert H. Whitcomb, '15, March 5
Gardiner C. Wilson, '15, April 16
Theodore A. Bulifant, '16, January 1, 1968
Howard S. Holloway, '16, April 27, 1967
Cleveland S. Loper, '16, October 19, 1969
L. Waring Wilson, '16, February 6
Jacob I. Ziner, '16, February 9
S. Phillips Houghton, '17, December 17, 1969
Arthur E. Keating, '17, March 23*
Henry A. Berliner, '18, May 1
Charles C. Johansen, '18, December 6, 1968
Bruce M. McDill, '18, January 27
Marvin Pierce, '18, July 17, 1969
Arthur Smith, '18, February 10*
John J. Falkenberg, '19, April 7
Charles M. Herrick, '19, June 23, 1969
Archie P. Cochran, '20, May 3
Albion N. Doe, '20, February 28, 1968
Alfred Hand, '20, May 2
Gordon W. Nelson, '20, September 10, 1968
Palmer Scott, '21, February 3
J. McKay Spears, '21, December 28, 1967
George R. Steininger, '21, April 27, 1965
William W. Bainbridge, '22, March 28
John A. Chapman, 22, December 29, 1969
C. Rogers McCullough, '22, January 13
Henry T. Slamin, '22, May 12
Paul B. Brown, '23, April 20
Alfred A. Clough, '23, November 24, 1969
Kenneth G. Crompton, '23, July 31, 1969
John A. Dow, '23, June 9, 1967
Charles V. Reeves, '23, March 24
Richard S. Bushnell, '24, January 21
Richard J. Chapin, '24, April 18, 1969
Herbert Duthie, '24, March 18, 1969
Ernst A. Guillemin, '24, April 6
Raymond Lambert, '24, March 11,
James G. Creveling, '25, April 24
Garland T. Rowland, 25, November 28, 1969
Edmund O. Rublee, '25, March 3
Eugene A. Chase, '26, July 31, 1969
George A. Fogg, '26, March 28
Sven A. Berg, '27, May 4
Russell E. Mc Cassey, '27, July 15, 1969
Westervelt A. Taylor, '27, August 1, 1969
Huyler B. Ellison, '28, February 23
John Y. Estabrook, '28, November 18, 1968
Maxwell M. Kessler, '28, April 28
Samuel Niedelman, '29, June 14, 1956
David W. Gurton, '30, July 24, 1969
George B. Shaw, '30, March 12*
Dewolf C. Thompson, '30, December 27, 1967
Samuel B. Zisman, '30, March 25
William A. Brown, Jr., '31, March 27
John B. Coyne, '31, April 24
Ralph H. Bassett, '32, January 6
Helen S. Burnham, '32, January 30, 1969
Isaac H. Schwartz, '32, March 20*
Frederick D. Drew, '34, July 12, 1969
Marion W. Shellenbarger, '35, November 1, 1967
John P. Fitzpatrick, '37, January 25
Baird W. Hodgkinson, '37, March
G. Richard Slonneger, '37, April 16
Louis L. Touton, Jr., '37, February 15
Stanley T. Walter, '38, January 4
Rasiklal H. Parekh, '39, January 25
Jack A. La Spada, '46, April 2
Francis B. Chalifoux, '47, August 13, 1967
Francis D. Harrington, Jr., '49, March 4
Richard F. Lee, '50, January 21
Louis B. Lambert, '52, April 14
Arthur S. Foster, '59, August 24, 1968
Leif R. Johnson, '59, October 9, 1969
Harold J. Pettegrove, '64, September 20, 1969
Gregory H. Berck, '69, April 4
Charles W. Smith, 3d, '70, January 1
*Further information in Class Review

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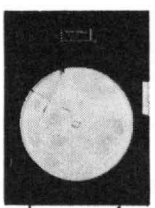

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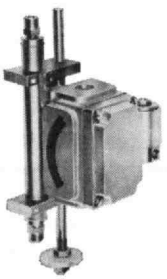

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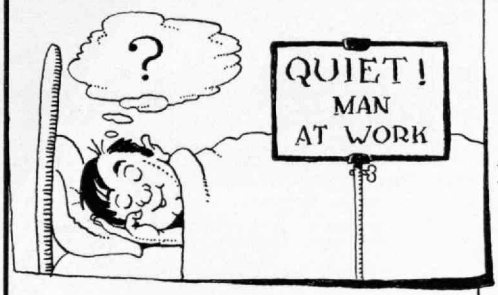
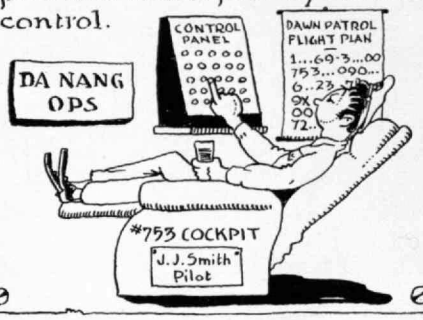


BREAKTHROUGH! Morris Salame '60, is one of a Monsanto team which has developed a new material for packaging soft drinks ~ it burns like paper.

LIFESAVER: Bob Mack '47 is the first person to operate a pilotless helicopter by remote control.

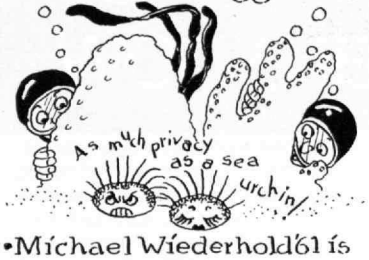


NON-RETIRING RETIREE: Alden (Dusty) Miller '20, with an urge to travel, found a congenial retirement occupation

.... he travels the world checking hotels for AAA accreditation. No dust on Dusty!

RESEARCH, DOWN~TO~THE~SEA TYPES:

- Daniel Smith '66 spent several months in Curacao studying the behavior of tropical sea urchins.
- Roy MacKintosh '64 is the authority on fertilization of sea urchin eggs.



- Michael Wiederhold '61 is working on the eyes of cherrystone clams.

GUESS WHAT, INC.

J. J. Bottomley, M·I·T '68
Pres., Bd. Ch., Treas.

TIME WAS when a company name gave some clue to its product ~ Smith Rubber Co., Jones Plate Glass Co. Not any more. Here are a few companies for which your fellow alumni work ~ many of which they founded and head.

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- Aquanautics, Inc. • Mark Systems, Inc.
- Engineering Computer International, Inc.
- Tymshare, Inc. • Unitrode Corp.
- Operations for Managematics, Inc.
- Intercept • Cues, Inc.
- Applied Decision Systems, Inc.
- SPACETAC • Synectics, Inc.
- Hy Comp, Inc. • Telemation
- Technical Forum Associates, Inc.
- Sof Tech, Inc. • Chem-Netics, Inc.
- Intercomp, Inc. • Codex Corp.
- Systems, Science and Software

M.I.T. Inc.

MEDITECH

- Medical Information Technology, Inc.

AUTHOR, AUTHOR!

- David Baker '38 writes a weekly philatelic column, "U.S. Classics."

- Athelstan Spilhaus '33 writes a weekly science feature on the comic pages,

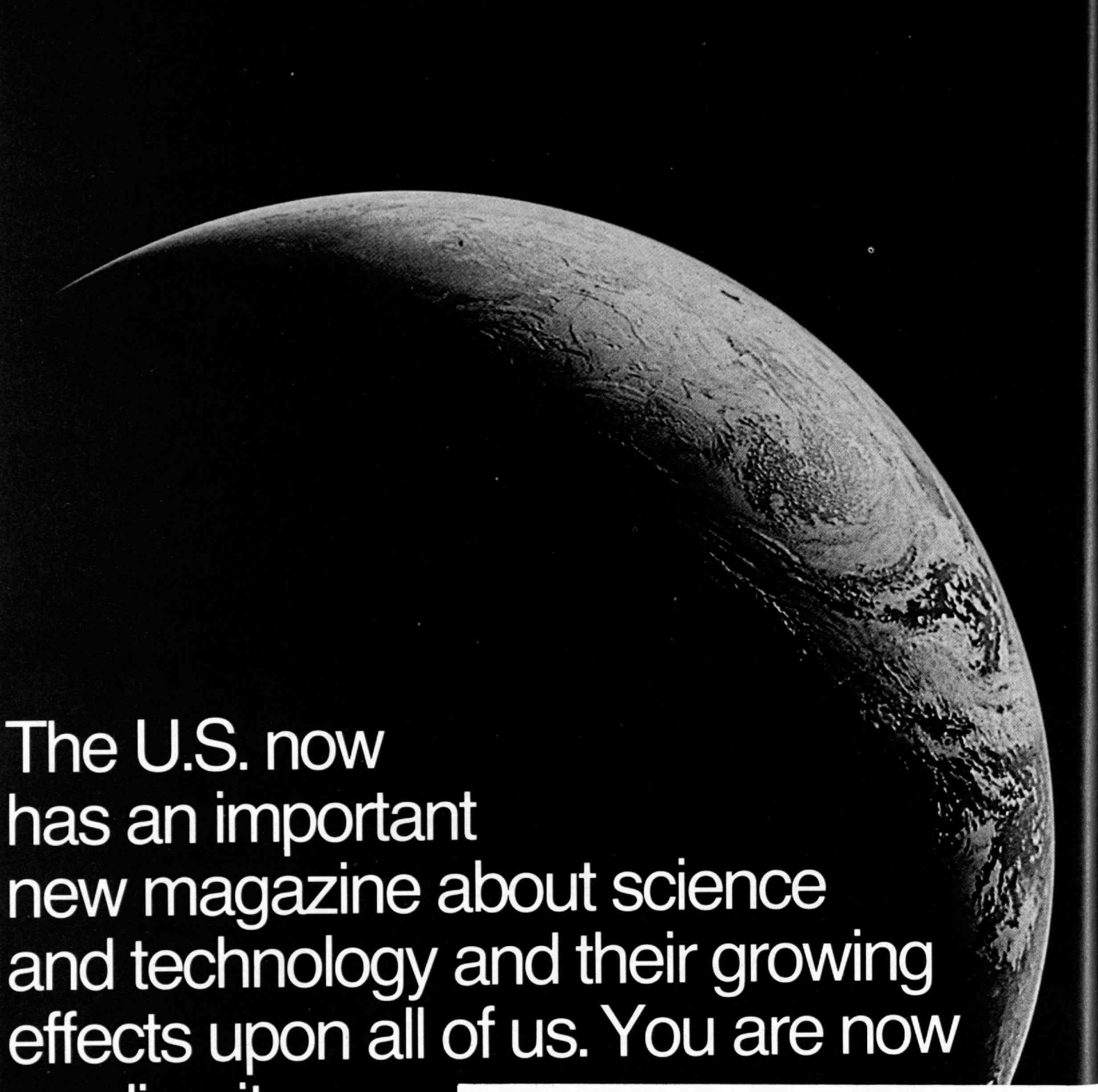
"OUR NEW AGE"

EARTHQUAKE CONTROL and

WHISTLES

for example.

H·B·KANE



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Alumni Correspondence

"Clear and Present Danger"

To the Editor:

I thoroughly agree with the comment which you headed "A Clear and Present Danger" submitted by David O. Woodbury as published in *Technology Review* for April, 1970 (p. 93).

Quite by coincidence, an editorial titled "Are the Universities Worth Saving?" appeared in the May 7, 1970, issue of the *Chicago Tribune,* just as I was reading Mr. Woodbury's letter. The editorial emphasizes the import and impact of Mr. Woodbury's comments and concluding inquiry. *(The first sentences of the editorial—which is too long to quote in its entirety—read, "American universities have been politicized by revolutionaries to such an extent that it is a serious question whether they can be saved. It is a serious question whether some of them are worth saving, particularly those which have suspended classes in support of student demonstrations and strikes for reasons which have nothing to do with the function of a university."—Ed.)*

I realize that probably the "intellectual-beautiful-people-Eastern-liberal-elite" of the M.I.T. faculty will sneer at both statements as unworthy of their serious consideration; for, like Nero, they will fiddle while their Rome burns and is reduced to rubble.

Perhaps M.I.T. might bestir itself to inquire if its alumni are as concerned as is Mr. Woodbury—just as the *Chicago Tribune* found 79 per cent of its polled readers approved President Nixon's decision to neutralize the Cambodian sanctuaries. In other words, the war in Vietnam has involved not only the North Vietnamese and Viet Cong but Cambodia and Laos as well—the latter having been the heretofore inviolable theaters of military supply and forces for the communistic aggressors!

Milton E. Parker, '23
Barrington Hills, Ill.

The author was formerly the Director and Professor of Food Engineering of Illinois Institute of Technology—Ed.

Apathy and Communication

To the Editor:

I should like to reply to David O. Woodbury's attack in the April issue (*page 93*) on the M.I.T. administration's handling of the seizure of the President's Office. I have rarely seen such a clear-cut statement of the paranoia of the right as directed toward the left. I have never been a sympathizer with the extreme left, yet I find myself being repelled by the reactions of the right. And Mr. Woodbury's quotation from Mr. Hoover only substantiates this. We all know Mr. Hoover's "patriotic" efforts to raise alarm in the nation to the level of his own pet paranoia. Apparently he has succeeded quite well. Both Mr. Hoover and Mr. Woodbury should realize that if the nation were well on the way toward a fair and just society, there should be no need to fear a communist take-over; for it would be doomed before it started.

I am not in favor of a socialist-communist tyranny; neither am I in favor of a right-wing tyranny which would do the *same* thing—namely, ban all out-of-line activities. A moderate, tolerant (I flatter myself) person fears suppression for its own sake, whether it comes from the left or the right. Does Mr. Woodbury honestly think that the "prohibition of any out-of-line activity" form of tyranny is any better than the "socialist-communist tyranny" of which he speaks? Frankly, given the history of our nation, I am in a sense more disturbed by his reaction than by the disturbances themselves.

I have always felt that M.I.T. was extraordinarily responsive to students and their wishes, and that it could afford to be because of the caliber of its students. And I think that President Howard Johnson has only upheld the reputation for fairness with which I had credited M.I.T. before. Mr. Woodbury, I was a student at the Institute during the days of rioting in the slums of our nation and during the elections of 1964. The apathy of the student body was something to behold.

The scientists and particularly the engineers of our country have an enormous effect upon the lives of all our citizens and upon our image in the world. That they should *not* be concerned about this was then the reprehensible fact. I frankly would be glad to see the whole student body demand a social conscience of M.I.T.—perhaps not in quite the way it was demanded in the incident which we are discussing, hopefully in a more constructive way. And I feel more confident of M.I.T.'s ability to listen than of that of any other school with which I am familiar. Then there should be no room for the extremes of either your side of the issue or for the left.

I should hate to believe that M.I.T. would deny the tradition of holding individuals responsible for their actions without punishing whole bodies of people. To Spain or Greece with you, Mr. Woodbury, and to Russia or China with S.D.S., for you might all learn something.

Cheryl A. Klitzke, '67
Ann Arbor, Michigan

Class Review

Copy for this issue of *Technology Review* was due from your Secretary about April 24. News which reached him after that date will appear in the July issue.

95

Sorry, no news to report on **Luther Conant.** Thanks to Phi Beta Epsilon for the invitation to attend open house on May 26th. I shall look forward to a visit there when there will not be so many present. I am very interested in all the improvements.

Last Sunday I was pleased to have a visit from John Nolan, Secretary-Treasurer of the Class of 1903. He brought several pictures, books, etc., re 1895 from the estate of **Fred Richards.** Hats off to him at 89 years of age for traveling from Somerville via the M.B.T.A. —**Andrew D. Fuller,** Secretary, 1284 Beacon St., Brookline, Mass. 02146

96

No news may be good news in some places, but it is not much help in trying to write class notes! If anyone has an item of interest for the Class I would be very glad to send it along via this column.

Don Severance, '38, the Executive Vice President of the Alumni Association, now has the bank book with your funds and the papers needed to transfer the money to the Fund. In July, when it will be credited to next year's drive, it will be credited as a gift for the seventy-fifth reunion. At present it amounts to $2,514.33.—**Clare Driscoll,** Acting Secretary, 11 Cliff St., Plymouth, Mass.

98

Such a long time since I have written! Seeing places new to us and preparing meals in the trailer kept me busy. We stayed south in California, Arizona, New Mexico, Texas, along the Gulf Coast, down the west coast of Florida, Key West and up the east coast. This is such a beautiful country that we want to travel again next winter to see places we missed. Now we are at home for a few months to care for the lawn and house we neglected. Best wishes for a pleasant summer.—Mrs. **Audrey Jones Jones,** Acting Secretary, 232 Fountain St., Springfield, Mass. 01108

03

Well the June *Review* has arrived amidst the excitement of commencement festivities and the joyous reunions of classmates. Yet we find it discomforting that as our alumni advance in years our class reunion attendance recedes in direct ratio. Accordingly, our class notes in succeeding *Reviews* should hence forth become our permanent source of unification.

Since publishing our report on **Howard Pew**'s activities in the March *Review* we have come across a good photo of him which appears on the next page. We were delighted to find it.

How refreshing to receive from **Paul R. Parker,** Course XIII, his autobiography; I include it to satisfy the eager interest of our remaining classmates. Paul has again ensconced himself in Kennebunk, Maine with its rugged coastline and maritime atmosphere. Paul compliments your active secretary for his success in continuing the autobiographical feature in our class notes. He writes: "Since graduating, my work has taken me too far from Boston for me to enjoy many of our class reunions, so I regret that I have not kept up with many of my classmates.

"Before going to M.I.T. I spent three years in the shipyard at Newport News, Va., where I had a good experience in the construction of gunboats, battleships and merchant vessels. I accordingly chose the course in naval architecture at M.I.T. when entering. While attending M.I.T., I spent the first summer vacation at the Bath Iron Works, Bath, Maine, and the second vacation period at the Newport News Shipbuilding Company. After graduation from the Institute in 1903, I went back to Bath, Maine, where I spent a year working on the battleship *Georgia.*

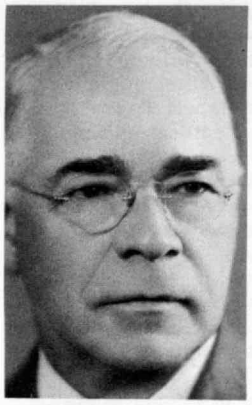
"I next spent several years with the Bucyrus Co. at South Milwaukee, Wisc., working mostly on mining dredges. While with Bucyrus, I was employed almost a year in Colorado, erecting two gold dredges for which I designed their wooden hulls. Then I was transferred by them to San Francisco as Pacific Coast Engineer. During a summer period, I went to Alaska to erect an extra gold dredger after framing the lumber for it in Seattle.

"During my several years in San Francisco, I enjoyed association with George E. Atkins, '04, Course XIII, on our general engineering work, the design of a steel hull and machinery for a gold and platinum dredge for Colombia, S.A.; the design and machinery for a gold dredge in New Zealand and design of a hydraulic dredge to deepen several ponds leading to Kalmath Lake, Ore.

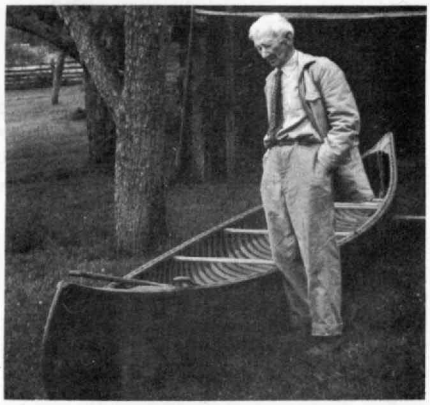
"In November, 1915, Elinor Elmore of Milwaukee, Wisc., and I were married. We sailed on December 31 for the Federated Malay States where I became manager of a tin dredging company. This required the building of a hydro electric plant to operate the dredge. We bought a steam ship to transport our dredge and power equipment from the U.S.A. with all our work accomplished by Chinese labor.

"After two years, we returned to California with a small daughter and I became vice president of the Benicia Ship Building Company completing wooden hulls for U.S. cargo steamers then used in the World War. The Benicia Company owned the Rimu Gold Dredging Company, Gray River Gold Dredging Company of New Zealand and also the South American Gold and Platinum Company. Accordingly, I designed several dredges for these companies that necessitated several trips to Colombia, S.A., and two to New Zealand. Mrs. Parker made the trips to New Zealand with me and on our return from the last trip to New Zealand via Australia and England, we accomplished a journey 'round the world. The time was now 1953 and I decided to finally retire to my beloved city of Kennebunk, Maine.

"You may be interested to know that our little daughter who came home from Malaya with us is happily married and has three fine sons. The oldest son, Stephen Parker Loutrel, '65, has a masters degree from M.I.T. and is studying for a doctorate in engineering at M.I.T. I have long enjoyed receiving the



Howard Pew, '03



Errett Graham, '05, and canoe

Review and always read with special interest the notes about the Class of '03.

Clarence M. Hardenbergh, Course II, 66 Groveland Terrace, Minneapolis, Minn., cheerfully writes, "Am still navigating." His 14 grandchildren keep him active as one of them belongs to the Appalachian Mountain Club and is familiar with its many trails; another teaches at Chicago University. Clarence enjoys his summer months at a son's home in New Hampshire—with ample facilities for gardening and a background of mountain scenery.—**John J. A. Nolan,** Secretary/Treasurer, 13 Linden Ave., Somerville, Mass. 02143

04

Last month I reported the deaths of three of our classmates. In this issue I would like to mention a few facts about each one.

Dan Comstock was a member of the firm of Comstock and Westcott, Inc., a Cambridge Research and Development firm. He graduated from M.I.T. in 1904 and continued his studies at universities in Berlin, Zurich and Basel from which he earned a Ph.D. in 1906. He later joined the teaching staff at M.I.T. remaining there until 1915. During World War I he developed methods to detect enemy submarines and in World War II directed many projects for the U.S. Government. His company, established in 1912, has a national reputation in such fields as physics, optics, instrumentation and chemical mechanical and electrical engineering. Included among the developments under his leadership is the invention of Technicolor. He belonged to many engineering societies and wrote many scientific articles. He was married to the late Joan Barton Comstock; he leaves two sons, Daniel Frost Comstock, Jr., and Charles Barton Comstock. Dan was very active in class affairs and his passing will be a great loss to us all.

Karl Peiler was born in Hartford, November 25, 1883. He attended local schools prior to joining us at M.I.T. and was employed at several firms as an engineer until 1910. In 1912 the Hartford Fairmont Company was formed to promote the field of glassware manufacturing machines. He joined this company in 1915 and in 1922 he was appointed chief engineer of the Hartford Empire Co., successor to the Hartford Fairmont Company. He became Vice President of the company in 1936 retaining this position until his retirement in 1954. In 1940 he was awarded the "Modern Pioneer" medal by the National Association of Manufacturers for "distinguished achievement in the field of science and invention. Like his classmate Dan Comstock he belonged to many scientific societies. Besides his wife, Doris Kirkby Peiler he leaves a son, a daughter, a stepson, a sister, ten grandchildren and two great-grandchildren. Karl was one of 1904's loyal boosters. I am indebted to Mr. Richard Feingold, Secretary of the Class of 1943, for this information about Karl. That certainly was cooperation and I wish to express my thanks.

Jasper Crane was a director and former Vice President of the du Pont Company. He prepared for Princeton at Newark High School. On graduation he studied at M.I.T. and the Princeton graduate school where he received his M.A. He entered his father's business, the Arlington Company at Arlington, N.J., manufacturers of pyrolin. In 1917 this company was taken over by du Pont. He headed many civic and religious organizations. He was also interested in horticulture and his greenhouse at his home was a show place. He leaves his wife Olive and three daughters, two sisters, seven grandchildren and three great-grandchildren. He will be greatly missed by his '04 classmates.

Mrs. Carle Hayward has been very ill this winter but is now at her residence, 1070 Beacon St. I know she would appreciate a card from her many friends who may read this column.—**Eugene H. Russell,** 82 Stevens Rd., Needham, Mass. 02192

05

At this writing no one seems to be interested in anything special for our 65th reunion, so we'll settle for the customary meeting at our table at Alumni Day Luncheon, hoping for a bit larger attendance to make it something special.

Gilbert Tower, Course XIII, has sent me a copy of the February issue of *The Bay State Builder,* which carries a three-page article on the need for "apartment villages to accommodate people of all income levels." The original article was directed to the people of his home town, Cohasset, Mass., where he is a member of the Planning Board but it was picked up by *The Bay State Builder* as applicable to the whole country.

A year or so ago, I wrote a story in this column on the canoeing exploits of our oldest classmate **Errett Graham.** Imagine yourself paddling about in Puget Sound. Thanks for the photographic evidence, Errett.

I have just one other bit of news to report—the death of **Herman T. Gammons,** Course IV. I note from the April 2 issue of the *Boston Herald* that he died April 1, at the Leonard Mose Hospital after a brief illness. He was a partner in the Boston law firm of Roberts, Cushman and Grover and had been a patent attorney for 60 years. He is survived by two sons, Harold L., '35, of Clinton, N.J., and Robert T., '33, of Natick and a daughter, Dorothy, with whom he made his home.

We must also report the death of **Carlton E. Atwood,** April 21, 1970.—**Fred W. Goldthwait,** Secretary, Box 32, Center Sandwich, N.H. 03227; **William G. Ball,** Assistant Secretary, Bay Shore Gardens, Bradenton, Fla. 33505

06

As these notes are written, along in April, crocus and forsythia are in bloom but the last of the snow has only recently disappeared and the weather is still chilly. We hope that Homecoming Day will be pleasant and balmy this year—and *dry.* Will you be there, with Marion and me and those two regulars—Abbott and Davol?

Awhile ago Fred Goldthwait, Secretary of '05, received the winter issue of the *South Shore Hospital News* because it

contained a write-up about one of the hospital trustees—**Samuel Langmaid Ware,** Course XIII. He was born in Somerville October 14, 1881, was with us all four years and became president of the Naval Architecture Society. For a few years Sam lived in South Weymouth and was a structural engineer with Shepley, Rutan and Coolidge, a well known firm of architects and engineers in Boston. During W.W. I, he was employed by the U.S. Shipping Board as a naval architect and continued for five years or more, three of which were spent in Japan and China. During W.W. II he was a designing consultant and supervisor with the Bethlehem Shipbuilding Corp. at their Boston office. He was a member—and a partner for 14 years—of Cleverdon, Varney & Pike, Boston consulting engineers, retiring along in the 40s to North Abington where he has continued to reside nearly 50 years and where "he has been active on numerous town committees and boards; was a trustee and deacon for many years of the North Abington Congregational Church." In 1911 he married May Davis who died in 1967. Their daughter Martha, is a special justice of the Hingham District Court, the first woman judge in Plymouth County.

Karl Frank Juengling, Course II, now hangs his hat at 12506 Edgewater Drive, Cleveland, Ohio 44107. **Ernest Maxwell Smith,** Course II, is still at the Brightview Convalescent Hospital in Avon, Conn. 06001, so we recently sent him another card from the Class.

We have one death to report, **Nahum Clark Willey,** Course XIII, on December 9, 1969 in the hospital in Bremerton, Wash. He was born in Aurora, Ill., on August 11, 1885, and while with us was a resident of Tech House; treasurer of the Naval Architecture Society; secretary of the Tech Y.M.C.A.; his thesis was "Speed Trial of a Gasoline Launch." For a few years he was with the Moran Company, Shipbuilders, Seattle and then became a "fruit grower" in Carlton, Oregon. During W.W. I, he was chief draftsman and technical assistant, Seattle Construction and Drydock Company before joining the U.S. Shipping Board Emergency Fleet Corp., Seattle. He checked plans from 10 steel yards for the Board and was supervisor of construction of wooden ships in the North Pacific District for the Board. His address continued to be in Seattle until W.W. II when he was busy at the Puget Sound Navy Yard in Bremerton, Wash., where he continued to live. He married Edith Maring who survives and to whom we have sent a belated note of sympathy.

As acting class agent I receive periodic reports from the Alumni Fund. Did you send in your gift for 1970 before June?—**Edward B. Rowe,** Secretary, Treasurer, 11 Cushing Rd., Wellesley Hills, Mass. 02181

08

Some time ago a list of those who are living and receive the *Review* was furnished. This list included only 20 living in Massachusetts. On writing for individual information we have received a brief outline from **Hobert W. French** who graduated as an electrical engineer and retired at 34 Elsinor St., Concord, Mass. From 1908 to 1913, he worked with the U.S. River and Harbor Engineering Department surveying Boston Harbor; from 1913 to 1917, he served as Sales Engineer to H. S. Kimball (M.I.T. '93) Chemical Engineers for paper mills in Easton, Mass., though their office was in Boston. After several years with the U.S. Engineers Office American Expeditionary Force in France where he was part of a small group to form the U.S. Army Gas Service, he was promoted to Captain and returned to the U.S. in January 1919. During the next two decades he was plant engineer at the Hammervill Paper Co., Erie, Pa. In 1940 he became Sales Engineer for factory equipment for several Pittsburgh and Cleveland companies retiring in 1965 when he moved to Concord, Mass.

Another M.I.T. graduate in naval architecture and marine engineering almost age 90 reports from Alabama. **Arthur F. Mohan** first worked as a draftsman for De Loach Manufacturing Co., of Atlanta, Ga., then switched to the Southern Power Co., of Charlotte, N.C., to design a stand-by steam plant. With this experience behind him, he accepted a position with the Kirkpatrick Sand and Cement Co. of Birmingham, Ala., where he remained the greater part of his working years, taking charge of their quarries and their sand and gravel plants. His next position was with the State of Alabama Highway Department as Production Engineer, doing some research on black top mixes and he ended up as chief of the equipment department with responsibility for six shops scattered over the state and all the department's equipment. During W.W. II he taught in the engineering school at Auburn University until the army took all the able-bodied men. Then he finished up taking charge of a repair shop of the U.S. Army Engineers. He says, "As I look back at this 40 years of directing the operation of heavy equipment the one thing that gives me a feeling of deep satisfaction is that no man was ever injured to the extent that he needed a doctor. I used to do a good deal of reading but as my eyes began to tire easily I spent more time listening to foreign language broadcasts over short wave radio. I walk three miles before breakfast and the same every evening."

A letter was received from Beth Anne Rice (Mrs. Robert P.) the daughter of **Chesney H. Criswell,** '08, who graduated as a chemical engineer. "Your letter really touched me, because I never knew that M.I.T. kept such records of their graduates. My father had always been proud of the fact that he graduated from M.I.T. As he was 85 (most of his generation had died) no obituary was published. On a separate sheet are the facts that might be a help to you.

"Chesney Harrison Criswell was born in Franklin, Pennsylvania, March 25, 1884. After he graduated from Washington and Jefferson, he attended M.I.T. and graduated in 1908. He entered service with the Great Western Sugar Co. at Greeley, Colo., in 1909 as a chemical engineer. He married Helen E. Nichols on June 18, 1913. He became superintendent of the Great Western Sugar factory at Greeley in 1919. In 1926 he started and was superintendent of the Great Weston factory at Johnstown, Colorado which is unique—processing sugar from molasses. He was promoted to District Superintendent at Denver in 1940 and remained in that position until retirement May 12, 1952. After retirement he resided at Estes Park, Colo. He died February 12, 1970, at age 85. He is survived by two sons, a daughter and seven grandchildren."

There are no changes of address reported this month. Class Day will be June 15, 1970. Hope the Class will be well represented.—**Joseph W. Wattles,** Acting Secretary, 1508 Casey Key Rd., Nokomis, Fla. 33555

09

We were pleased to receive the following communication from **Art Shaw:** "The season grows late and if I am to accomplish anything this year by making a report I must be at it! I have attended two meetings of the M.I.T. Club of Southwest Florida this winter. The first included the wives and was most pleasant socially and also entertaining with a fine lecture on time lapse photography and its use in biological research. The second a few days ago was a luncheon meeting where we were brought up to date on the situation at the Institute by Peter Grant of the Alumni Association; very instructive and I was pleased to have a short chat with Peter who was in my son Richard's class.

"This evening (March 13) I had a rather sad conversation with **Hardy Cook**'s wife. Hardy has been in a nursing home for about two years after a succession of strokes and is presently very ill. I hope to be in touch with his son who will be here in a few days and I will keep you in touch. Mrs. Cook and I had pleasant recollections of our 25th reunion when our young children attended and played together.

"A note from **Tom Desmond** yesterday bore a Naples, Florida, postmark but was on his home stationery and gave no Naples address. This was where the Wallis's spent many winters. This is not too far from here but we haven't taken any long drives this year. My back is behaving itself. I haven't quite dared to indulge in the surf bathing which I have usually enjoyed. I have used the heated pool some for 'hydrotherapy.' Betty keeps well. We take not-too-long walks on the beach and play shuffle-board which to my surprise I can manage without discomfort. Our social life with the numerous friends we have made here

over the years is quiet but very pleasant. We plan to head for home about May 1, making the motor trip in easy stages as our comfort dictates."

We were sorry to learn of the illness of Hardy Cook. He was a very aggressive tackle on our class football team, and he appears with the other members of the team in a photograph which hangs in our game room.

You will probably receive this number of the *Review* just prior to the M.I.T. Homecoming which begins Sunday, June 14. A detailed description of this event and the registration form have already been mailed. We hope that a number of the Class will be able to come, particularly to the luncheon at noon on Monday the 15th.—**Chester L. Dawes,** Secretary, Pierce Hall, Harvard University, Cambridge, Mass. 02138; **George Wallis,** Assistant Secretary, Wenham, Mass.

11

John A. Bigelow of Marlboro, Mass., died on February 8 after a long illness. He was born in 1889 in Marlboro, graduated from the Marlboro High School and in architecture from M.I.T. He was a direct descendant of one of the oldest families in Marlboro and became deeply interested in the history of that city and an authority on it. While at Tech he was quite active in student activities, having been on the 1911 relay team, assistant art editor of *Technique,* 1911, in the Tech Show chorus and a member of musical clubs.

After a few years with J. William Beals' Sons, Boston architects he returned to Marlboro where he continued his work in architecture and a little later became city engineer, a post he held for 22 years until his retirement in 1959. He was acting city treasurer and tax collector during World War II and served on the Board of Library Trustees, being its chairman for many years. In this position he played a major role in the restoration and addition to the library after it was damaged by fire in 1967. The auditorium in the library was named for him. John was secretary-treasurer of the Chamber of Commerce for many years, chairman of the city's planning board, a trustee of the Marlboro Hospital and a member of the Rotary Club, having been its secretary for a few years.

John's wife, Anne, passed away in 1967. He leaves a brother, a sister, a daughter, four grandchildren and 9 great-grandchildren.

O. R. Schurig of Schenectady sent in this account of his doings: "I entered the junior class at M.I.T. in 1909, having had preparatory work at Harvard where I received a degree of A.B., cum laude, class of 1910. At M.I.T. I took up electrical engineering and received the degree of S.B.E.E. in 1911. My chief memory of the graduation exercises for me was my shaking knees when I was called upon to give a report on my thesis from the speakers platform.

"My first job was with Stone & Webster Engineering Corp. which assigned me to the Pawtucket, R.I., Electric Co. I did meter testing for one and one half years, traveling with horse and buggy from house to house, the manager being the only one privileged to have an electric auto for company business. I then progressed to switchboard operator in the power station there. Since my ultimate aim was to do teaching, I accepted an offer to become an instructor at M.I.T. in the electrical measurements laboratory. I was soon promoted to secretary of the Electrical Engineering Research Division under that great man, Dr. Kennelly, during the period of affiliation of M.I.T. with the Harvard Engineering School.

"In 1914 I wrote various articles for the American handbook for electrical engineers (*Pender's Handbook)* as an associate editor. In 1917 I heard through our classmate, Norman Lougee, about an opening at the General Electric Co. in Schenectady under Dr. Steinmetz. I jumped at the chance, was accepted and had the great privilege of having that genius, Dr. Steinmetz, come into my office every working day, sit opposite me there and say 'Well what's new?' This association continued for six years until 1923 when he died. My work was chiefly in the fields of electric circuits and power transmission, and I wrote 25 technical papers relating thereto for publication.

"In 1955 I retired from the G.E. Co. and was offered a professorship in electrical engineering at Union College which I most certainly welcomed and enjoyed. I found the college atmosphere, the eager young students and the faculty family most appealing and stimulating. I regretted leaving this post, when I retired again in 1960, more than any other that I had had.

"I had served in the army as a reserve officer from 1926, entering as a specialist with the rank of captain with the ordnance reserve and retired in 1950 with the grade of colonel. Since service in the reserve is part time, except during war periods, this service was performed concurrently with my civilian duties. I did however serve on full time active duty from 1940 to 1945 as executive officer of the Ballistics Research Laboratory at Aberdeen Proving Grounds, Md."

I have two new addresses: **Eldred B. Hawkins,** 63 East High St., York, Pa. 17313; and Col. **C. Phillips Kerr,** 7717 Jansen Drive, Springfield, Va. 22152.

I am sorry to have to report two deaths: **Henry W. Van Hovenberg** of Mt. Pleasant, Texas who was a native of Eau Claire, Wisc., and graduated in sanitary engineering; and Dr. **Victor P. Klapacs** of Brookline, Mass.—**Oberlin S. Clark,** Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

DO YOU REMEMBER the student reporters on the *Tech* staff who labored faithfully on their assignments, arising perhaps at five o'clock to do their stints and still get to class at nine? I recall a stern rebuke from a professor when I arrived at class a few minutes late and finally had to give up the work in order to pass his course.

We have received from **Wally Murray,** Course X, the promised story of his trip to Patagonia and Antarctica from which he returned last March. He writes, "First, we flew non-stop from New York to Buenos Aires and after a short stay continued on to Trelew, Argentina. From there we drove to Puerto Macrya at the entrance to the Valdez Peninsula. We spent the next three days on the peninsula, sleeping in tents on the ground, using air mattresses. It was great fun. Thousands of sea lions, many elephant seals and countless birds, including a few pelicans, furnished us ample entertainment. The sea lions have no fear of man and we could walk within a few feet of them. They would roar loudly but would never attack anyone. Sheep-raising is the main occupation of Patagonia, and we visited a large estancia, having 40,000 sheep. The weather here is too dry for cattle grazing, in contrast to northern Argentina which, with its abundant rainfall, can grow great herds of cattle. We then went by car to Punta Tombo, there we found millions of Magellenic penguins with their burrows in the ground. Everywhere these penguins were sticking their heads out of their burrows, and we also saw great numbers standing or marching on the beach. It was most interesting to watch a long line of penguins, all marching in step in true military formation. Other penguins were seen in the water or resting in the shade under thorn bushes. There were also other birds, particularly skues, which would fly at you, sometimes hitting you, in an effort to drive you away from their nests. We next drove to Comodoro Rivadavis, the Tulsa of the Argentines, with many oil wells in operation, reminding me of Texas and Oklahoma. The next day we visited a petrified forest at Sarmiento, where we first encountered hilly country. From Comodoro Rivadavis we flew to Punta Arena in Chile. Here we boarded our ship, the *Lindblad Explorer,* which took us south to Antarctica. It was a small vessel, but most comfortable, and designed as a passenger ice-breaker. At first we sailed through beautiful channels between the islands of the Tierra del Fuego archipelago. Here on both sides were great snow-covered mountains with glaciers between them. We sailed out of the Beagle Channel, near Cape Horn, and into Drake Passage, which separates South America from Antarctica.

"We made about a dozen stops in Antarctica, twice on the mainland. The others were on islands just off the coast of the continent. We visited five experi-

mental stations, the one owned by the Russians, and the Palmer Station of the United States, all used for deep freeze operations. At every station, even the Russian one, we were cordially received. From the Palmer Station, we sailed south towards the Antarctic Circle. Our first try was a failure, since we ran into packed ice so dense that our ice-breaker could not go through. We then went farther west and tried again. This time we succeeded in crossing the Antarctic Circle and soon turned north to Tierra del Fuego. There we made a short stop at Ushuaia and then sailed north to Punta Arenas where we took a plane to New York. The scenery of Antarctica is the most spectacularly beautiful of any continent I had seen. In February, the temperatures are no colder than in New England at the same time of the year (mid-summer there and mid-winter in New England). If anyone wants to take a really 'out of this world' trip, I highly recommend Antarctica." . . . Thank you Wally, I'll think it over but am sure my wife will still vote for Florida.

Harold Mabbott writes from Swarthmore, Pa., "There is little news here. However, I can fortunately say that I continue to have reasonably good health, though, with hearing uncorrected, quite good sight, and teeth in good shape, though I once lived on a diet of beans while working as a waiter at the old Union at 20 cents an hour. A plate of beans then cost but fifteen cents, however—net profit each day, one nickel. Fortunately, I can still enjoy a good meal, and have several preferred eating places within a fifty-mile radius of home where I can go with friends and enjoy a ride at the same time. I could easily write a book on places with a "Duncan Hines" recommendation, where the cooks apparently never went to cooking school; but the bartenders seem to be getting rich."

A letter from **Jonathan Noyes,** Dallas, Texas, advises of a recent auto trip to Arizona and California, during which he enjoyed the hospitality of **Cy Springall** and Marjorie in Scottsdale. They entertained him royally and showed him the many points of interest in the vicinity. While in Glendale, California, he visited with **Henry Babcock,** who, he says, looks little older than he did in 1912. Henry is still actively working as a valuator and real estate consultant, and was just leaving for Houston, Texas, to conduct a three-day professional course. Henry still summers in Goshen, Mass. Johnny also reports that he phoned **Bill Lynch** at his home in Beverly Hills but talked with his housekeeper. She advised that Bill is in good health physically but no longer plays golf and she takes him out for a daily walk. Bill's wife passed away several years ago. The housekeeper did not think it advisable for Jonathan to visit him. We are grateful for this information, since as reported, inquiries have brought no reply. We sincerely regret however, to learn that Bill is apparently no longer up to par. Bill retired in 1955 as chief executive of the California branch of The Aluminum Co. of America in Los Angeles. A letter from **Ken Robinson,** Course II, reads, "I believe the last time I wrote I had been cleaning out the gutters of this 93-year-old house near Pittsburgh where we have lived since 1935. In 1958, I put in a new furnace all by myself. I still do all the maintenance work about the place, including carpentering, painting, plumbing, and electrical work, so I keep very busy. Some of these days we shall be obliged to pack up and head for California, where my son, Dick, has been trying to get us for years. The older we get—I am now 84—the fewer friends we have. They are all dying off! However, we still spend two or three weeks in New England every summer and a couple more at a camp with a friend on a lake in northern New York State. Should New England ever slide into the Atlantic, we shall start for California the next day. We are hoping to be able to make the 60th reunion in 1972, and if we do not, it will be because Alliene is then playing a harp while I am sizzling below."

I always enjoy hearing from **Cornelius Duyser,** Course XI, who has a style all his own. Since his wife died in 1965, he has continued to live alone in his New Hartford, Conn., home, and claims to be the world's worst cook and housekeeper. His two married children and three grandchildren live in nearby towns and among his bright spots are his weekly visits and Sunday dinners at the homes of one or the other. He now travels but very little, but each year has a sizeable garden which produces a sufficient amount of vegetables for both families as well as for himself, with a year's supply of potatoes and frozen corn. And all this at the age of 84! He still claims his favorite indoor sport is cussing out the administration, and writes, "If you desire some examples of what is going on, just take a look at one of our new 'fresh water colleges' and see what kind of a bunch in Washington crowd is trying to hand to the public as college material. Then there is the loud wail about pollution and at the same time the fostering of the sources; also the fourth class mail fiasco, and more and more good land being taken for highways. I also deplore the manner in which the unions are allowed to operate, while the government claims it is trying to curb inflation. Do not misunderstand me. I realize that the unions are a necessity, but the country needs protection from their excesses. Nevertheless, I am glad still to be able to live in this wonderful country. Don't try to pump up any sympathy for me. I have had more from life than most people. The Dutch have a word for it and my folks were Dutch. My Dad used to say, 'I'd rather have people envy me than sympathize me.' ". . . Good for you, Cornelius; you have changed but little over the years!

Ken Barnard and his wife are well and still active at their home on Cape Cod. He writes that his grandson, Jim Calvin, and wife are still in Okinawa where he is in the navy, and that they have now adopted the Korean boy and girl as planned. They now have four children under four years old. Ken is quite proud of this position among our classmates and may also qualify as the only one with 10 great-grandchildren.

We are saddened to learn of the passing of **Page Golsan,** Course VI, on March 2, which occurred after a brief illness at his home in South Laguna, Calif., as reported by his son, Page, Jr., '34. After graduation, he worked for a short time with the Southern California Edison Co., as valuation engineer. Page then transferred to the Great Western Power Company in San Francisco and became vice president in charge of engineering. He soon went to New York City with Ford, Bacon and Davis, Inc., engineer where later he became vice president and director. His term was interrupted for seven years to serve as vice president and manager of Great Western Portland Cement Company with headquarters in Kansas City. Following the sale of this company he returned to Ford, Bacon and Davis, Inc., and retired in 1955 when in charge of their western operations in Los Angeles. For the past 15 years he has been acting as director and organizing consultant for several local firms in Los Angeles. Most of us remember the 1912 Class Roster which Page published and distributed to us in 1935. Since retirement he and his wife had travelled extensively.

It is also our sad duty to report the death of **Bill Schmiedeke** on November 4, 1969, in San Pedro, Calif., where he had recently moved after the passing of his wife, Elma. Bill had been engaged many years in Los Angeles as a structural engineer until he retired in 1967.

You have received notice from the Alumni Association describing in detail the plans for the 1970 M.I.T. Homecoming on June 14 and 15. It is hoped that a goodly number of 1912 men are planning to be present and have a get-together at the luncheon and social hour. There were but eight men last year. Remember, time is flying!—**Ray E. Wilson,** Secretary, 304 Park Ave., Swarthmore, Pa. 19081; **Jay H. Pratt,** Assistant Secretary, 927 Fair Oaks Ave., Oak Park, Ill. 60302

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Will we see you at the Homecoming June 14 and 15 at M.I.T.?

We have talked several times with **Charles Thompson** and Ellen and **Ellis Brewster.** All is well with them. Also, we checked with **Jack Farwell.** He has returned from his check-up in the hospital. He appeared to be in a very happy mood as usual.

Bill Mattson describes very interestingly the Mattsons' latest trip and we quote in part: "Jo and I have just returned from a long auto trip—5,000 miles, and two months' time in the South, mostly

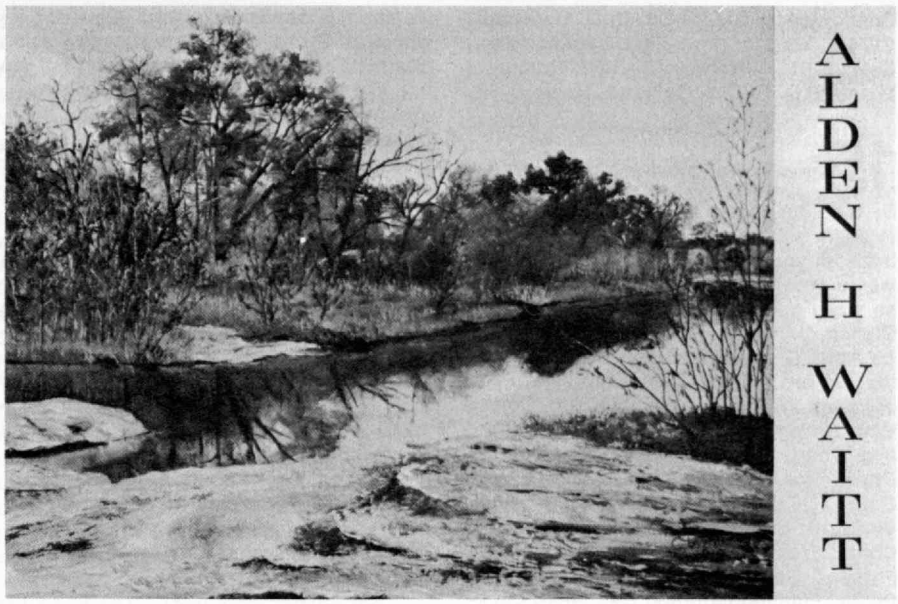
in Texas. We left Denver the latter part of January and our first stop-over was Delhart, Texas. Then a week in San Antonio where we visited Federal Judge and Mrs. Henry Graven. Mrs. Graven is Jo's sister. February 1, we drove to Rockport, Texas, a small town on the Gulf of Mexico near Corpus Christi. We had rented a cottage and lived there for the entire month. Several boat trips, much time on the beach (too cold for swimming) and auto trips in and around Corpus Christi. Excellent weather. Another of Jo's sisters and her husband were with us—a good vacation. In March we started west and north from Rockport. Overnight stops in Del Rio and El Paso, Texas, then Tucson and Mesa, Arizona. In Mesa, I recalled reading in our class notes in the *Review,* that my very good friend of our student years, Bunny Brett had moved from New Jersey to Mesa because of his wife's health. This was several years ago. Then early last year it was stated Mrs. Brett had died. Was Bunny still in Mesa? Well, I phoned **C. W. Brett**—it was he. "Bill, I'm so glad you phoned. I just remarried three days ago," he said. So the Bretts and the Mattsons had a wonderful visit and reunion. The bride is a charming, vivacious lady and Jim ('they now call me Jim, not Bunny'), looks as young as he did 50 years ago. After a trip to Hawaii, Jim will sell his house in Mesa, and the couple will live in Scottsdale, 3930 North Granite Reef Road. We stayed in Mesa nearly two weeks at a very fine hotel-motel. Then a start for home with stops in Socorro and Taos, New Mexico. We arrived in Denver the middle of March, just a few hours before the beginning of a big four-day snow storm, the worst in many years. Why didn't we stay longer in the South? Next time we will."

A grateful note has been received from Mrs. Joseph C. Mackinnon and we quote: "Please extend to the members of the Class of 1913, M.I.T., my sincere appreciation for their kind and thoughtful message I received when Mr. MacKinnon passed away."

We were interested in the brochure we received from the Institute listing the many summer courses to be given in architecture, economics, engineering and science management and technical writing. If any of you guys and dolls are interested write for further details directly to M.I.T. Office of the Summer Session, Cambridge, Mass. 02139, Room E-19 356.

A letter was received from the Graduate Alumni Association of the Sloan School of Management stating that dinner meetings are held every month, with outstanding guest speakers. If you are interested, please communicate with Paul M. Konnerman, Sloan School of Management, 50 Memorial Drive, Cambridge, Mass. 02139.

Change of address: Madison W. Christie, 395C Main Blvd., High Point, Boynton Beach, Fla. 33435. Have a pleasant summer, but take a few minutes to write of your vacations, hobbies, and particularly your achievements.—**George Philip Capen,** Secretary and Treasurer, 60 Everett St., Canton, Mass. 02021



Lithograph of an oil painting by Alden Waitt, '14, from an invitation to his April showing at the Shook-Carrington Gallery in San Antonio, Texas.

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As these notes are written we are perusing the invitation to the latest showing of **Alden Waitt**'s artistic handiwork in San Antonio. The invitation cover is a handsome lithograph of one of his paintings. There is no doubt of the professional quality of Alden's work, and I am glad that more 1914'ers will have a chance to view it. I am reminded that we also have another very competent artist among our classmates who is a northerner, **Ormonde Clisham,** who lives in Nashua, N.H.

We have news of the death of **Arthur Fowler Petts** on October 29, 1969, at his home 182 Linden St., Everett, Mass. Arthur was officially connected with 1914 during his third and fourth years as assistant instructor in Course II. In 1917 he became associated with the D. M. Dillon Steam Boiler Works in Fitchburg. In subsequent years he had several connections with engineering firms in the Boston area; particularly the Ellis Tool and Die Company in Chelsea. We remember seeing Art and his wife at our 50th reunion.

Harold Bours Richmond died suddenly at home in Cambridge May 7, 1970. He had returned with Florence several weeks previously from Florida where they had spent the winter, seemingly in somewhat better physical health than in recent years.

M.I.T. will miss Harold—or Rich as he was known to many. He was an instructor in electrical engineering for several years not long after graduation. During the war he had a lieutenant's commission in the 15th Artillery C.A.C. After the war he joined the General Radio Company where in the course of time he became president of this rather substantial organization which specialized in electrical and radio testing equipment. His interest in M.I.T. continued, in particular in Alumni affairs. He was an early secretary of 1914 and was a head of the Alumni Association for some time.

We hope you will forgive us if we lapse into some personal recollections because Harold and I struck up a personal association that started when we first met in Boston. The underlying motivation was a strong common interest in radio, or wireless as it was known. It was wireless telegraph with a spark coil transmitter. He had a small station at his home in Medford. I had a small set in my room on St. Botolph Street in Boston. We had an installation in the corner of the Lowell Labs in Boston. Our common interests had a few interesting ramifications. I can recall during a vacation period at my home I received a penny post card with a brief note which was viewed by my family with some amusement. It was signed "Your affectionate spark." Perhaps we can properly close these notes—"Station HAA calling Station HBR" and signing off "With affection and best wishes."

We have a gossipy note from **Paul Owen** who is still living at 123 E. 37th St., New York City. He extends his congratulations over the success we have had with our cataract operations, which was apparently considerably better than his were a couple of years ago. Paul's wife died about two years ago. He retired from Cross and Brown in March, 1969. We judge that Paul would not mind a contact with some of you Fourteeners who still live near the big city.

Here are a couple of corrected addresses: Lester L. Downing, 108 Crescent Rd.,

Concord, Ma. 01742; Edwin D. Hayward, 2174-A, via Mariposa East, Laguna Hills, Calif. 92653.—**Herman A. Affel,** Rome, Maine. P.O. RFD 2, Oakland, Maine 04963

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By the time you're reading this our 55th reunion will have come and gone and we hope all you who attended enjoyed it. It was a great pleasure for us here to see so many good old classmates again. Our Boston dinner at The M.I.T. Faculty Club on April 10 is again conclusive evidence that we are still the Class Supreme. Present were Wayne Bradley, Moosup, Conn.; Whit Brown, Concord; Jack Dalton and Pop Wood, Peterboro, N.H.; John Dalton, Providence, R.I.; Ray Delano and Larry Bailey, Duxbury; Charlie Norton, Martha's Vineyard; Stan Osborn, West Hartford, Conn.; Fred Waters, Marblehead; Frank Parsons, South Yarmouth; Max Woythaler, Framingham; and Ben Neal, Lockport, N.Y. From Metropolitan Boston—Clive Lacy, Larry Landers, Azel Mack, Archie Morrison, Frank Murphy, Wally Pike. The Pirate and Gerry Rooney and Bill Smith and our young members Herb Eisenberg '52 and Jim Hoey '43. Fifty per cent were "long distance" men.

What a fine spirit to come to spend a convivial evening with old friends. Surely a splendid class group. The lively, enjoyable and enthusiastic meeting opened with the old Pirate giving his Buccaneer cheer with his usual stimulating spirit—"We are Happy!" Cocktails and an excellent Bill Morrison dinner put us in a pleasant and nostalgic mood. The "long distance" men received special recognition. The attendance and this spirit are glorious examples of our outstanding class spirit and friendships, surely a fine group—long may we stay together.

The main business was the discussion of the final plans for our 55th at Coonamessett. **Wally Pike** was to handle transportation from our M.I.T. headquarters to the Inn and from class dinner Monday night to Bill Smith's. A great help by Wally. **David Hamburg** donated all the printing and stationery for the reunion. Many thanks to him. He continues the same kind and generous spirit that his father, Abe, showed for our Class. **Jack Dalton** closed the dinner with a spirited and interesting talk and explanation of the undergraduate situation at M.I.T. which had had so much unfortunate publicity. We were indebted to Jack for his clear and straightforward talk which, I am sure, clarified our thinking and feelings. Lest he be quoted, **Charlie Norton** guardedly refrained from any comments on that nationally publicized accident at Edgartown last July. Smart Charlie!

After the dinner **Wayne Bradley, Jim Hoey** and **Bill Smith** went over to our apartment to see Fran—a delightful close to the evening. Our welcome guests Ben and Charlie stayed over with us.

This winter on a Grace Line cruise through the Canal to Valparaiso, Chile, we spent a day in Guayaquil, Ecuador with Gus Gross '50. Unfortunately, Gus's charming wife Carmela was away, but we had the pleasure of meeting his sister and her husband, an attorney there. In the equatorial heat and humidity it was a pleasure to sit around Gus's pretty pool and relax in his comforably air-conditioned house. They all went to dinner with us on the ship and joined the native combo with their Spanish songs. Gus is a successful electrical engineer there and with the spread of air conditioning he has become very busy. He represents one of the large states-side manufacturers. He is executive director of the Committee for the Development of the Guyus River Basin—a $100,000,000 project. It requires his flying all over North and South America for conferences with engineers and bankers. This is a most important position for him and is a splendid tribute to his success there and his M.I.T. background.

Phil Alger is resigning his faculty position at Rensselaer Polytechnic Institute at Troy, N.Y., as, he says, the driving to and fro in present-day traffic is too much for a senior citizen. He is publishing a new edition of his book, *Induction Motors.*

About the middle of February **Alice Anderson** left on a cargo-passenger cruise for two months to Capetown then up through Nairobi to Rome, Paris and England. En route she sent us cards from those fascinating far-off places and from London she wrote us that it snowed one day in Paris, late in March and that Paris and Rome were crowded with European travellers. She met our ambassador, Walter Annebury, at a theatre party in London. It's good to see her enjoying herself. . . . **Sam Berke** missed our Boston dinner on a Florida trip, but planned to be at the 55th. . . . From Durham, N.C., **Lucius Bigelow** writes:—"Still holding the fort down here. Have a good office in the new Gross Chemistry Building at Duke, I offer free consultation in elementary organic chemistry, and tour the laboratories for a brief time each week. Wish, indeed, I would be sure of attending the reunion, but as of now this is problematical." It's truly remarkable how he keeps going so actively.

In planning to go to our New York dinner on April 17 (to be reported next month), humorous **Dick Bailey** wrote: "I do very much look forward to The Pirate and you and several other good classmates, including Ben Neal. I will be there on April 17, 1970. I just received the current issue of the *Technology Review,* and want to thank you for all the interesting news of so many old 1915ers. The news about me was nice and I thank you for it, and will "dream of" a few awful corny stories. If you and the others do not want to hear any, just tell me so, and I will keep my big mouth shut! I plan to see Speed Williams and his wife a day or so before the dinner. I do hope to be present with all the rest of you good gentlemen." . . . **Wayne Bradley**'s Moosilauke Inn, at Warren, N.H., looks more attractive than ever and would be a comfortable place for any of you to spend your summer vacation in the mountains.

Ben Neal had Magaret and **George Easter** for dinner at the Buffalo Country Club, early in March. They had just returned from a quick two-week trip to Tokyo, Hong Kong and other such ports. Ben says they thoroughly enjoyed it. They were in Florida for November and December and in the spring went to the Adirondacks. How they do get around. And at that age, for on April 4, they celebrated their fiftieth wedding anniversary.

Mona and **Clive Lacy** were in Orlando for six weeks and had a chance to see some of the spectacular Apollo equipment at the Kennedy Space Center. . . . Helen and **Boots Malone** stayed at Sarasota until late in April. Wonderful. . . . Lucy and **Harry Murphy** visiting one of their sons in San Francisco wrote that it's the most fabulous city they had seen in the United States. . . . Charlotte and **Pop Wood** were at the famous Gulf and Bay Club at Sarasota and that sharp Pop wrote his observations of the bikinis he saw there on the beach. Ah, me! This non-paying job of preparing class notes to meet the relentless monthly deadline of the *Review* editors is tough—how about it, "help Azel."

It's sad to report the loss of these classmates: **Bowman S. Atkins** died January 22, at Silver Springs, Md.; **Albert V. De Beech** died August 24, 1969, at St. Petersburg, Fla.; **George R. Urquhart** died March 17, at Largo, Fla.; **Herbert H. Whitcomb** died March 5, at Ayer, Mass. We have written to the widows and families of these men.

Our class sympathy goes to 1913 in the loss of one of their popular classmates. **Joe MacKinnon** died March 19, at Cambridge. At his memorial service in Kresge Chapel at M.I.T. one of the eulogists said that when Joe was dean of students at M.I.T. he "knew all the rules and how to get around them." Joe showed me that unusual ability way back in 1946, when beyond the duty of his position he secured some very important help for a young freshman I was interested in at the time. Joe was a great guy!—**Azel W. Mack,** Secretary, 100 Memorial Drive, Cambridge, Mass. 02142

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It's here—the 54th reunion—on June 12, 13 and 14—and again we'll celebrate way out on the Cape in Chatham, where we've had so many of our annual reunions since the 35th in 1951. Hear how our dashing president, **Ralph Fletcher,** said it on April 1: "Once again, it is a pleasure to call to your attention another class reunion. . . . We will return to the Chatham Bars Inn where they offer a scenic location, excellent facilities and have always been generous with their attention to our needs. On this weekend, we hope to develop the initial plans and the framework for our 55th reunion. We will also focus a great deal of attention

and discussion on the stewardship of the present administration at M.I.T. throughout the recent turbulence on the campus. . . . I look forward to seeing you in June. All best wishes."

Our Van

Last month we reported that **Van Bush,** as well as Dr. James B. Conant and Lt. General Leslie R. Groves, '17, received gold medal "Atomic Pioneer Awards" in February from President Nixon at the White House. We didn't then have the citations but how we have. Here's the one for Van: "For his exceptional contributions to the national security as Director of the Office of Scientific Research and Development in marshalling the resources of American science for national defense during World War II and for his pioneering leadership as a Presidential Advisor in fostering the establishment of new Federal agencies, including the Atomic Energy Commission and the National Science Foundation, which have made possible the unprecedented growth of scientific research and development in the last two decades."

In addition, a news release was issued by the Office of Public Relations at M.I.T. on the occasion of Van's 80th birthday, March 11, noting the many important items in his lifetime of amazing accomplishments. You all know about most of them so we'll not repeat them here. But a two-column spread in the *New York Times* on the occasion of Van's birthday included a number of interesting items.

For example: "Once or twice a week he shows up at M.I.T. to discharge the nebulous duties of honorary chairman of the corporation. But usually he's at home with his two poodles, Nip and Tuck, as he was the other day as he discussed his life and times through a thick haze of pipe smoke. 'When I retired from Washington, I was out of direct scientific work and decided to do things I was totally ignorant on,' he said of the years following retirement as head of the Carnegie Institute in 1955. 'I would not go back into analytical machines when the young fellows could cut rings around me. So I went on the board of A.T. & T. and Merck.' . . . He takes a philosophical view of the gulf that has developed between science and the military. 'I've seen it happen before,' he said. 'It's not just the scientists—it's the general public attitude. I can remember the 1930's when Hitler built his plan and we were sound asleep. Well, it's happening all over again. This tendency to withdraw and say we do not really need the military is just part of this reaction.' . . . 'He was a master craftsman when it came to working around obstacles,' said Prof. Edward Bowles, who was a student of Dr. Bush's at M.I.T. in the 1920's and who later served him in Washington during the war. Indeed that skill came in handy when it came to dealing with Pentagon generals. 'To see him in action with the generals was an exhibit,' remarked Dr. Conant, former president of Harvard, who was Dr. Bush's deputy at O.S.R.D." Many happy returns of the day, Van!!

Travelers and Vacationers

A letter postmarked "Fiji Islands" was received from Mildred and **Art Shuey** as they were heading homeward from their March-April wanderings in New Zealand and Australia, with stops yet to be made in American Samoa and Hawaii before landing in San Francisco. Art says they rested in Roratura, N.Z, for three days while he fly-fished for trout. "I caught two of their small ones, five-and-a-half and four-and-a-half pounds but they were the largest I ever caught—rainbows. We welcomed Queen Elizabeth in Wellington from the Royal Yacht *Britannia* and again in Christ Church in a pouring rain (we saw her on T.V. in our room as we wouldn't brave the downpour). After touring New Zealand for two weeks we flew to Melbourne, Australia and visited my cousins for a few days, then on to the perfect city of Canberra, which by the way was planned by an American architect named Griffin (he must have been M.I.T.) in 1907. They have named their midtown lake 'Griffin' in his honor." We all hope to see Art and to welcome our new Mildred into the Class of 1916 at the reunion at Chatham Bars Inn.

In March, from Harbour Island in the Bahamas, we had word from the **Maury Hollands** who had two months in a beach cottage "perched on top of terraced sand dunes, a hundred feet above the clear blue Atlantic, with waves pounding the beach day and night like the sound of African drums 2500 miles to the East." This was for years one of Gyps and **Cy Guething**'s favorite islands in the sun, is were Beatrice and **Walt Binger** visited on their recent Audubon Society trip, and is what Maury (who met Walt there) calls "another sun-spot for '16ers." Apparently, transportation on the island is by motored golf carts (there is no golf course) and "shank's mare."

Once again (your Secretary reporting) Dolly and **Peb Stone** had their usual several weeks in the Caribbean in March-April, first in Tobago for ten days and then to their Young Island, called "paradise" by some, "with its 20 acres of flowers and fruit trees just 200 yards off St. Vincent" in the West Indies. Their exciting card from Tobago features "crab racing at Eastertime on Buccoo Point," in which several spidery crabs compete on the hot sands, overshadowed and cheered on by at least 60 onlookers, each would-be-winner aided by a tickling stick in the hands of its owner or befriender.

Peb's comment reads: "You wonder what we do in Tobago—well, this isn't one of the things!" But he is more specific in his card from Young Island, giving an outline of their busy schedule, so busy in fact that they say they hardly have time to write. That schedule: "breakfast at 9:00; check on the fish pool at 10:00; read a few chapters till 11:00; snorkel till 12:00; rum till 1:00; lunch till 2:00; nap till 3:00; swim till 4:00: a few more chapters till 5:00; martinis till 6:00; scrabble till 7:00; dinner till 8:00; bridge till 10:00; bed till next morning." This makes graphically clear their hardly-have-time-to-write business. Moreover, Peb adds: "Had to get a larger belt the other day." But they surely looked good when they came back. If you are interested in details, just write Peb.

And we also have word from Bermuda, mid-April, from Nell and **Don Webster** who emigrated for a month "while spring catches up with Cape Cod." This is a fourth or seventh visit, we understand, since way back in the 1920s. Don says they are glad to escape from their housebound dry-heated air and treat their skins to some ocean humidity.

Some time earlier Don sent us an eight-line verse about "supermarket math" from the *Wall Street Journal*'s "Pepper and Salt" section (maybe you saw it), ending in these four lines: "You're likely to feel mathematically inadequate, unless, of course, you are an M.I.T. graduate, Shopping, per se, doesn't make me sick—It's all of that fifth grade arithmetic!" Have you told your family how to figure cents-per-ounce? Approximately?

The **Theron Curtises** spent an is-it-customary three weeks in March in Clearwater Beach, Fla. While there, they talked with Helen and **Dick Rowlett** and note that Dick has not been too well. Then: "Now for the spring work around our places. Each year it looks like more of a chore." But we are sure he is grateful that he can say "places" instead of just "a place." . . . Sylvia and **Vert Young** indicated in March that they might after all have to miss the reunion as they would be heading for Southwest Africa, South Africa, Australia and New Zealand either early in May or early in June. No doubt they must need a rest from all the heavy work on their plantation since last August when Hurricane Camille did such heavy damage. And we will hope that Sylvia takes along a whole bagful of pencils and pens and notebooks for writing down her impressions of places, things and people so that we can once again quote segments of her colorful and penetrating observations.

Mail Bag West

From the west, we have bits of news and sound philosophy coming in from Kay and **Irv McDaniel.** We wish they too could be traveling all over, and that Irv could start another series of travelogue commentaries, full of vigor and verve, like some of his past essays on the real meaning of things in deep Egypt or in the wilds of Ceylon. But right now, in Laguna Hills, Irv says they "have never had so many cymbidiums (orchids); we also have all the new varieties of roses and the older standbys. And the cineraria are terrific!" (We had to look up that last one in Websters *Third New International Dictionary!)* . . . **Saul Hoffman** of Los Angeles says that at 75 he does not travel much any more but is still active every day doing abstracting in magneto-hydrodynamics, vertical take-off and landing of aircraft, heat pipes, biomedics, irradiation polymerization and grafting, etc., etc. And Saul has several items to be proud of: son Myron is full professor

in aeronautics at the University of California at Davis, son Allen has accepted full professorship in chemical engineering at the University of Washington at Seattle, and daughter (Phi Beta Kappa) has her masters and is going for her Ph.D. in linguistics. For philosophy, Saul adds: "Accept what is daily and all things will come out just fine."

Virginia and **Joel Connolly** of Tucson continue to keep in touch and in their last message, indicated they were sending us a Chinese art calendar. This we will bring along to the reunion in June—it probably is a pleasant reminder of the many fruitful years they spent in Taipei where Joel was very active in public health projects. Hopefully the Connollys will come east to their summer place in Brewster in time to attend the reunion this year.

Stewart Keith in Denver reports his first great-grandchild, and says this June a granddaughter will graduate from C.S.U. and go into the Peace Corps. He expresses the hope that the doctors will let him and Jessie take a long trip east this summer. . . . Commenting on the picture for last year's reunion, **"J. H." Murdough,** retired department head of civil engineering, Texas Technological College, in Lubbock, Texas, says the ladies appear as sweet and lovely as ever, and none of the men looked as though he had missed a meal. And old friend, Hy Ullian, "looks well able to go another couple of rounds at Frank Kanaly's Tech gym. But I would ask to be excused." Then J. H. says the March issue "recalled to mind a handsome redhead, a friend of freshman days. It is difficult to have to think of him as subject of a reducing diet. Good old L. O. Frank." To J. H., "the luxury of retirement with its freedom from appointed tasks is still savored."

Mail Bag East

L. O. Frank Hastie, our diet control expert (see the March issue) sends us a seven-year-old full beard photo of himself (says he now looks just the same) and gives us hope that he'll show at the reunion, thus: "Wrote Ralph Fletcher a few days ago that Amelie and I were planning to get up to Cape Cod and Martha's Vineyard this spring and that, as I could afford only one trip, I would certainly try to include the reunion, at least briefly. I am beginning to feel more and more like Mark Antony's description of his lack of talents. Of course, he was a big old kidder but I am serious." . . . **Spotts McDowell** of Pittsburgh comments on the 1969 reunion picture: "What a distinguished-looking group!" Says he is not too active, takes an occasional trip to the "big city" at the fork of the rivers, had a good year in 1969, "and 1970 starts off with equal promise."

Elbridge Devine of Pelham, N.Y., is still on a consulting basis but not too active at it he says. "Just enough to keep the rust from becoming 'too deep.' " . . . **Chet Richardson** writes from Youngstown, N.Y.—an area in which, until recently when Ray Brown died, three Course XIV '16ers have been rather close together for decades. The third is **Pete (Osborne) Mahlman** who has had a health problem, is in the Fairchild Manor Nursing Home in Lewiston, N.Y., but "in good spirits." Chet is now a full-time cherry grower, but adds "maybe that is stretching it although I spend say about 1,000 hours a year at it. Had our largest crop, 28 tons, in 1969, and more than half the trees are still too young to bear." Chet adds: "**Bill Leach** has moved completely from Youngstown. Helen had an ancestral farm on the River Road—they have sold it and are now living the year round in Texas."

After his serious hospital bout in December, we trust **Howard Claussen** is going to enjoy his latest and newest boat. We have a picture of it—a Post 34-foot cruiser, custom-built, he says, for a New Bedford millionaire, "sleeps six, HiFi-radar, running hot and cold water and shower." And, "to top it off, twin Diesels! Although it has power obviously to outrace anything this side of Newport, we are not hot-rods at all—but we get such rough seas we want to make port fast."

Dan Comiskey writes from Needham: "I enclosed two sad clippings, one about Ed Reynolds '17, whom I knew very well at Chauncy Hall and at Tech. He went from Course VII in public health to Harvard Medical and was very successful in Danvers and Peabody as a fellow physician in the area with Paul Duff. Dan adds that **Izzy Richmond** is active in new school-building design, **Bill Drummey** keeps in the news, as well as **Hy Ullian**—all in the Boston area. He mentions receiving a nice long letter from **Frank Bucknam** of Auburn, Calif., during the Christmas holidays. He adds: "Today, February 16, in the new order of things in Massachusetts, is the state holiday observance of Washington's Birthday (22nd)!! No wonder the young people are confused at M.I.T. as elsewhere!" . . . And in March, **Dick Hunneman** wrote briefly: "Recently ate in the M.I.T. Student Center with all the freaks. Like our generation best."

The joint 1916-1917 monthly luncheons are still much enjoyed in New York at the Chemists' Club—at noon on the Thursday following the first Monday of the month, from September through June. The February and April luncheons were particularly delightful, for Julius Stratton, '23, joined us and shared his views on things generally. The April luncheon also included '16ers Rudi Gruber, Francis Stern, Herb Mendelson and your Secretary, plus '17ers Dick Loengard, Enos Curtin, Bill Hunter and Clarence Seely. If you would like to receive regular notices of these luncheons, just make the request to one of our two highly-qualified luncheon-notifiers, Peb (Leonard) Stone, '16 Assistant Secretary or Dick (R. O.) Loengard, '17, 21 E. 87 St., N.Y.C.

And so we close for the present. Don't forget those reunion dates, June 12, 13, 14. See you there, we all hope. And keep writing just a little but writing often to any of your officers including your still-willing-to-work Secretaries.—**Harold F. Dodge,** Secretary, 96 Briarcliff Rd., Mountain Lakes, N.J. 07046; **Leonard Stone,** 34-16 85th St., Jackson Heights, N.Y. 11372

17

There was a meeting in Washington last year that did not attract much attention but had special interest for us. It was the night when representatives of 30,000 air line pilots paid homage by awarding an Honorary Membership in the Air Line Pilots Association, International, to Charles Augustus Lindberg. It was an anniversary of the landing of the "Spirit of St. Louis." Among the veritable "Who's Who" in aviation was our **Ken Lane** for he was one of the three originals of the "WE" team. Ken was a Wright Company specialist, who was originally assigned to Lindberg's competitor for that trans-Atlantic flight, Clarence Chamberlain. However as Chamberlain's plane was not ready, Ken found himself standing astride the cowling of the "Spirit" that gray morning in 1927, hand-pouring gasoline from 5-gallon cans into the tanks of that airplane. There were many exchanges of quips and memories among them being a reference to Ken's gasoline pouring. This caused Ken to comment, "I want to correct a misconception right away, gentlemen. I did not pour that gas through a chamois, but through a 200-gauge wire screen." When Ken was asked if he had any tips to pilots, he replied by describing his prowess as a pilot in an ancient plane called the "Hisso-Standard" by saying," All I remember, gentlemen, was keep those damn rocker boxes below the horizon." One wonders, were those the good old days?

If and when you are at the Faculty Club during June be sure to see the exhibit of **Jim Flaherty**'s water colors in the display case along the side corridor.

A recent newspaper picture of **Stan Lane** receiving an award as President Emeritus of the New England Baptist Hospital shows him to be hale and hearty. Some day Stan may give us a run-down on some of the notables he hosted as President of the hospital such as Clare Booth Luce, ex-King Umberto of Italy, Sir Anthony Eden of Britain, Ted Williams, and tell of the night he was almost prevented from entering the hospital by the Secret Service when President Johnson came to call on Sen. Edward Kennedy.

Our hats really should come off to **Ed Payne** for he writes, "I save millions of dollars for you tax payers every other day." Ed is with the National Security Agency of the Deparment of Defense as a Communications Engineer of Systems which has always been his field.

Barney Dodge is on the go again, this time, according to a card to **Ken Bell,** to Iran where he is teaching a course in

chemical engineering for one semester at Pahlavi University in Shiraz. The Bells returned over the Pacific aboard the *Argentina Maru,* a seventeen-day trip which they enjoyed very much. Returning to their home in New Hampshire they found that it had been broken into and all the hi-fi record players, tape recorders (movie and still) had been stolen as well as the Civil War sharp-shooter's rifle, the only irreplaceable item.

We regret to record the death of **Edwin D. Reynolds** on December 1, 1969. After graduating from M.I.T., Dr. Reynolds received his M.D. degree from Harvard Medical School and took many graduate courses. He was an active practising physician on the North Shore.

Word comes from Englewood, Fla., of the marriage on March 30, of Anne Parker and Walter E. Stribley. Mr. Stribley is English born, Canadian reared and resides in Florida. The entire Class of 1917 sends best wishes to the happy couple.

Our distinguished classmate, **Arthur E. Keating,** died on March 23, 1970. His contributions to engineering and education have been outstanding. He founded the Bridgeport Engineering Institute and was its first president (see *Technology Review for March, 1970).*

Tentative dates for our reunion at Northfield are October 6 and 7. More formal notice will be given later.—**Stanley C. Dunning,** Secretary, 6 Jason St., Arlington, Mass. 02174

18

Remember 1914/1916—just Rogers Building, Walker Building, and Engineering Buildings A, B and C. Then came 1916/1918 with the magnificent great court and all the buildings in this new wonderful complex. Recently, in April, I participated in an evening's discussion at Endicott House in Dedham about twelve miles from the Cambridge campus; it is a retreat where small groups can have seminars isolated in its ivory tower atmosphere from the tensions of the M.I.T. classrooms and research laboratories. Endicott can house as many as 34 guests—conferences up to 60 participants have lasted from a few hours to three months. The setting—a chateau with 20 acres of gardens and woods—is beautiful and conducive to creative and introspective study. What a wonderful adjunct to the M.I.T. learning process. Would that it had been available to us in our student days.

We are happy to report good news about **Ed Rossman.** A welcome letter from his Dorothy tells of a good winter for both of them in Tucson, Ariz. They plan to leave in early May for their Paris, Maine, home for the summer. We look forward to seeing them—and you—at the 1970 M.I.T. Homecoming June 14 and 15 in Cambridge.

We recently spent an evening with Dorothy and **Clarence Fuller,** and Jean and **Julian Avery.** Clarence is semi-retired, but is busy writing a history of the Foxboro Co. In addition, he is interested in genealogy and is tracing his family tree back to the early-1600 era. Julian is also retired, but is busier than ever with a number of consulting arrangements with several clients in his field. We have been in close contact with Jean and Julian since we are both attending an interesting series of motion pictures on "Civilization" by Sir Kenneth Clark, sponsored by the Boston Museum of Fine Arts. Last fall, the Averys moved from the New York area to Chestnut Hill in Boston where Julian now conveniently has his office at his home.

It is with great sadness I report the death on January 27, 1970 of **Bruce McDill** and that of **Arthur Smith** on February 10, 1970. Both attended our 50th reunion, and those of us who were with them then feel a little extra gulp in our throat—maybe a silent prayer for a minute—and grateful for having been together with them on such a mutually happy occasion. In a later issue I hope to fill you in on some of their history since 1918. A most touching eulogy for Art was delivered by his granddaughter, and with it I close this issue.

"How is one able to put into words the great love and admiration one human being has for another? How is it possible to describe a man who in his own quiet way touched the hearts of all who knew him, and all who knew him loved him. What can anyone say about a man who won respect and admiration by his mere presence.

"Behind his thoughtful, solemn eyes, sparkled the pride and love he had for those close to him. And when he smiled he could light up an entire room. . . . To see my Grandfather beam with approval when I spoke to him made everything I ever wanted or did seem worthwhile. He possessed an enduring patience and understanding with people, a clever, warm sense of humor, and an unquenchable thirst for knowledge. . . . We will always remember him with great love and respect. He was a strong, vital, happy man who died in a manner in which he lived: in peace.

"It has often been said that when a great man dies the whole world cries. When my Grandfather lived the whole world seemed to glow. And when he died he took with him a piece of everyone's heart. But unselfish in death as in life, he left behind his love and warmth to comfort those dear to him."—**Max Seltzer,** Secretary, 60 Longwood Ave., Brookline, Mass. 02146

19

We are sorry to be late in announcing the death of one of our fine classmates on October 6, 1969—**Isidor Slotnik.** Ark Richards notes "too bad, a real nice guy." "Duffy" was a contractor and a civic leader. He was from Chelsea and lived in Newton, Mass. A member of the Boston Government City Commission and a former president of the Associated General Contractors of Massachusetts, he had been treasurer of J. Slotnik Co., contractors, since 1933. He had also served as president and chairman of the Beth Israel Hospital Executive Committee.

News has just arrived that **Charles M. Herrick** passed away June 23, 1969, in Albany, Ga.

George Michelson wrote that he is still active with no thoughts of retiring. He was in Sarasota Fla., in February. . . . **Marshall C. Balfour** has moved from South Kent, Conn., to 111 Morgan Creek Road, Chapel Hill, N.C. in the surroundings of the University of North Carolina.

Francis A. Weiskittel of Baltimore, Md., drove through here on April 12, from Cocoa Beach to Fort Lauderdale and left a note for me. Sorry to have missed getting together. His twenty-one-year-old daughter will be married on June 20, 1970.

Will Langille wrote and sent correspondence from classmates. **Amos Prescott** writes: "Enjoying retirement in new house in Smoke Rise, Butler, N.J. . . . **Ed Doten** sent your secretary a note of best wishes for his new apartment life in Delray Beach. Ev has spent some time in the Henry Ford Hospital and reports he is now all straightened out. . . . **Roy Burbank** covered the reunion in his note and expects to be at Homecoming, 1970. . . . **Nelson Bond** writes from Washington, D.C. He is still active in communications. . . . **S. Albert Kaufman** wrote from Tewksbury, Mass.

Don Way and Barbara were for the 1919 reunion at Chatham Bars in June 1970. . . . **Harry Kuljian** is chairman of the Executive Committee of Kuljian Corporation, Philadelphia. His 50th reunion experience exudes joy and pleasure. . . . **Don Flynn** wrote that he lives on a three-acre country plot 20 miles west of Stroudsburg, Pa., on Route 209. . . . **Jim Reis** writes from Los Angeles that he will be in Japan in June, 1970.

Alfred W. Hough writes from Chatham, Mass., and was all for the '19 get-together at Chatham Bars Inn as were **Izzy Patterson, Ben Bristol** and **Paul Blye.**

Ed Moody and his wife Helen will make an extended trip in August to North Carolina, Kentucky, Indiana, Illinois, and Ohio. . . . **Milt** and Catherine **Loucks** will be in Europe from May 10 to June 10—Switzerland and down the Rhine to Frankfort, train to Vienna and then through Austria, Salzburg, Munich, Innsbruck and Zurich.

Karl and Allegra **Rodgers** are spending the winter in Spain because of his emphysema. . . . Your secretary and wife had dinner with the **John Stevenses**

April 7, celebrating his birthday. They are well and enjoying the Florida sunshine. . . . Your secretary will head north in June and expects to be in Ohio, Indiana, New York, Canada and Washington, D.C., returning to Florida late in October.—**E. R. Smoley,** Secretary, 50 East Road, (11E), Delray Beach, Fla. 33444. Tel. 305-378-4537

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Greetings and heartfelt sympathy to all members of our Class who were unfortunate enough to miss our 50th. News of this gala half-century event will appear in a subsequent issue.

A pleasant and thoughtful note from Warren Henderson, the Class Secretary of '33, says: "Your classmate **Albert V. Dumas** from far off Quebec, with his charming wife, Evangeline, attended the M.I.T. Fiesta in Mexico City; a most agreeable and lovable couple." Your description of the "Count" and his wife is unanimously seconded by the Class of '20, Warren.

Featured in the news of Cocoa Beach, Fla., *Today,* the daily newspaper of that region, is an article on Cocoa Beach senior citizens Irene and **Alden Thresher** who are described as always active in the Space Age Senior Citizens Club. "Bat" has a one-man show at the Cocoa Beach Public Library. Painting has been his hobby for twenty years or more. Although the show is confined to his watercolors, Bat does oils as well. We certainly wish we could have taken in this exhibition. The newspaper column mentions that Irene was visited by Mrs. Lucille Kattwinkel, her sister-in-law and widow of the late Dr. E. E. Kattwinkel, '23, a beloved and honored member of our alumni body.

Johnny Rockefeller's present address is 307 West Jersey St., Elizabeth, N.J.

From Rosslyn Farms, Carnegie, Pa., **Ted Bossert** writes: "Emily and I have had a great time since I retired from Alcoa. At first we spent a lot of time traveling. A metallurgist by profession, concerned with research and development in the aluminum field I found myself joining the Home Botanical Library of Carnegie Mellon University, became "Curator of Botanical Iconography" or portraits with the result that this library has the largest collection of such pictures in the world. I really enjoy the work and what with this occupation and occasional trips I have a hell of a time getting things done at home." More power to you, Ted, and congratulations on your fruitful retirement career.—**Harold Bugbee,** Secretary, 121 Everell Rd., Winchester, Mass. 01890

21

We are pleased to note the astute judgment of the Homecoming '70 committee in appropriating another of the reunion devices originated by the Class of '21,

Philip R. Payson, '21, took this photo of his classmates last March in Beach Club Golf Course 19th Hole Restaurant, Naples, Fla.: (from left to right) Herbert W. Gwynn; Richard P. Windisca; George A. Chutter, 50th Reunion Chairman; Garvin Bawden; Philip T. Coffin; Harry P. Junod; and Royal A. Wood—all of the Class of '21. Present but not in the photo was Edwin F. Delany, '21.

but regretful that our planned class dinner for Sunday evening, June 14, is being preempted by the committee's exotic international buffet. The revised program format for Homecoming '70, which starts early on Sunday afternoon as you now know, has just been received as these words are written and too late to give you any advance warning of our enforced cancellation of the annual '21 Class dinner. The compacted new event-filled arrangement for Sunday and Monday programs does not afford opportunities for older classes to relax and reminisce by themselves around a dinner table and we will welcome your suggestions as to how we can meet our future needs for fun and fellowship without upsetting the committees' salient efforts to attract younger groups. We might have dinner together at the conclusion of Homecoming '71 next year to top off our 50th reunion. In any case, we'll have an outstanding reunion so you and your wife should plan now to "Join '21 in 'Seventy-one" for the time of your lives at our one-and-only Golden Anniversary!

Reunion rally

We are privileged to "tune in" on a letter sent by Marion and **Philip R. Payson,** 5031 Northampton Dr., Tanglewood, Fort Myers, Fla. 33901, to Ruby and **Paul Hanson,** 16444 Balsa Chico Ave., Space 85, Huntington Beach, Calif. 92647, which says, in part: "We are pleased that you are both well after Paul's operations and that he is improving so fast. Our Class 50th Reunion Chairman, **George A. Chutter,** Box 305, East Dennis, Mass. 02641, phoned from his vacation spot in Englewood, Fla., to invite us to a luncheon meeting on March 9 in Naples at the Beach Club Golf Course 19th Hole Restaurant. Meeting first at the winter home of Edna and Philip T. Coffin, 1950 Gulf Shore Blvd., Naples, Fla. 33940, were Marion and George Chutter; Kay and Edwin F. Delany, 8 Welgate Circle, Wollaston, Mass. 02170, wintering at the Culusa Club, Naples; Wini and A. Royal Wood, 15 Charlton Hill, Hamden, Conn. 06518, and Marion and me.

"The ladies went to the Man o' War Restaurant and the rest of us to the 19th Hole, where we met Herbert W. Gwynn, 1100 Eighth Ave., Naples, who asked about you; Richard P. Windisch, P. O. Box 2005, Naples; Henri Pell Junod, 2000 Union Commerce Bldg., Cleveland, Ohio 44115, and Garvin Bawden, 10 St. George St., Duxbury, Mass. 02332, all wintering in Naples—a turnout of nine members of the Class of 1921. I am enclosing a Polaroid photo I took before Ed Delany arrived, showing seven of the group, and am sending a copy to Cac Clarke with a copy of this letter.

"George went over the tentative plans for our 50th anniversary in June, 1971, which Marion and I hope to attend together with you two. At M.I.T.'s invitation, we will all stay in McCormick Hall. We'll shortly receive a preliminary letter from George (and, hopefully, a Class Directory, too—Cac). A big turnout is expected and we can all sport our classy new cardinal jackets. I believe you have some of this special '21 stationery and hope you'll use it as I am, to write to classmates and urge them to attend—ask George Chutter if you need more stationery."

Prior to Chutt's trip, he and Marion together with Maxine and your Secretary had a delightful meeting with Helen and **Ray St. Laurent** at their home in Man-

chester, Conn. George had just seen **Arnold C. Rood** at an Alumni Advisory Council meeting and reported having lunch with **Paul H. Rutherford,** Vice Chairman of our 50th Reunion Committee. Ray continues to show marked improvement from his hip operation and recently got back on his feet from a bout with pneumonia.

Besides the luncheon described by Phil Payson, the Chutters report seeing Madeline and Rufe Shaw in Sanibel, Fla., but were unable to reach John A. Scott in Daytona Beach. They did see Lillian and **Joseph G. Kaufman** in Daytona—who say they will attend the 50th.

You now have a letter and Amity Fund report from Class Agent **Edouard N. Dubé** who also wrote on behalf of Estate Secretary **Edmund G. Farrand** and **Irving D. Jakobson,** chairman of our 50-year Gift Committee.

A living memorial

Elsewhere in this issue you will find an account of the outstanding honor which Rogers Corp., Rogers, Conn., has paid to our late classmate, **Joseph M. Lurie,** onetime technical director of the company, in the form of an extensive and unique practical monument devoted to fostering progress and creativity as he did in his chosen field.

Travel tales

We have a long series of interesting letters and comments from Madeline and **Ralph M. Shaw, Jr.,** 137 E. Warren St., Beverly, N.J. 08010, transmitting complete sets of regular and commemorative stamps from every spot they visited on a long trip to the South Pacific, including Australia and New Zealand. Incidentally, Hexalphas should note that Rufe's home location has not changed—the front of Shawnee Hall is still 608 Riverbank in Beverly. Excerpts from the many letters: "We are at sea after two glorious days in Tahiti. A few from M.I.T. are on this cruise but none from '21. . . . We could not go ashore at Roratonga so the philatelic people came aboard, including a lovely Polynesian girl—the postmaster. Herewith are Cook Islands and French Polynesian stamps. . . . Following Western Samoa and Niue Island, we were in New Zealand and are now on the Tasman Sea to end our ocean trip at Sydney. . . . Greetings from Australia. Sydney is in a building boom. There are no hippies and the girls wear the shortest skirts we have seen. . . . It is cold, bleak and raining here in Johannesburg, South Africa. Gold is pouring out of the ground and the place is booming with tall structures being erected on all sides.

"(From Barbados) I could not get any Venezuelan stamps on our short overnight stop and in Brazil they use stamp meters, so there are few adhesives for sale. Rio is gorgeous with a skyline of apartments and a natural setting that is unique. . . . It is fair and hot here in Virgin Islands National Park, St. John. There is no smog and I have a good coat of tan. . . . We returned via Miami and drove to Naples where we had cocktails with Edna and **Phil Coffin** who showed us pictures of their 16th grandchild. They spend half their time in their Naples apartment and the remainder at their home in Pittsburgh. I looked up **Roderick K. Eskew** in Sanibel. He had been injured in an equestrian accident. Marion and **George Chutter** blew in and had lunch with us. Looked up **Herbert K. Nock** in Pompano Beach and had a pleasant visit with him and his wife. He had been secretary of the Course VI-A 'Night Rounders' in 1921!" The most recent of the Shaws' colored photo Christmas cards showed them at the Acropolis in Athens on an earlier trip. Thanks for the letters and the largesse, Rufe!

Alex and **Munroe C. Hawes,** 320 Boston Blvd., Sea Girt, N.J. 08750, also cruised the South Pacific to Australia and New Zealand, returning via the Orient, Expo 70 in Osaka and Hawaii. A brief note from Milford Sound in New Zealand said they were just ahead of the group from England's royal family. "New Zealand has such a variety of mountains, lakes and gorgeous gardens. Tahiti, especially Bora Bora, was an outstanding place to visit." The Hawes couple say the budding spring flowers in their own beautiful Sea Girt garden are no match for the beauty they left in Hawaii.

Emma and **Leon A. Lloyd,** 35 Spruce St., Westerly, R.I. 02891, are still reminiscing over their spur-of-the-moment trip to London, Zurich, Geneva, Lucerne, Interlaken and a cable car jaunt up Mont Blanc last year with daughter Barbara and her husband after Al had recuperated from the flu which kept him from joining our Class interim reunion in Mexico. Their biggest news is the arrival last November 9 of their first grandson and sixth grandchild, Mark David Lloyd.

Betty and **Dugald C. Jackson, Jr.,** Tetrastremma, Harmony Hills RFD 2, Havre de Grace, Md 21078, prepared a detailed map of their extensive tour of Scandinavia, involving travel by boat, train, fjord ferry, bus, plane and private car. They specially praise the hospitality of the Norwegians and Danes and the magnificent scenery of Norway. The Jacksons also toured northern Germany and the Netherlands before sailing to New York.

Charlot and **Robert W. Barker** and Maria Helena and **Viviano L. Valdés** represented the Class of 1921 at the Fiesta of the M.I.T. Club of Mexico City last March, per a welcome note from a thoughtful friend, Warren J. Henderson, Secretary of the Class of '33. In welcoming the Barkers back to our midst, we neglected to note that he is the senior partner of Hess and Barker, Philadelphia manufacturers of printing presses; president of Robert W. Barker, Inc., and that they live at 713 Clarendon Rd., Narberth, Pa. 19072.

Vox Pop

Elma and **John B. Mattson,** 69 Sargent St., Winthrop, Mass. 02152, report a count of their clan has reached the magic number of 21, including 11 grandchildren. They add: "We are eagerly looking forward to the 50th." . . . Mary and **Laurence O. Buckner,** 2630 Durham Rd., Haines Acres, York, Pa. 17402, sent a personal note in which Buck says he still does some lecturing on heat pumps and consulting on power equipment and wiring. . . . Marty and **William C. Ready,** 1904 Flora Rd., Clearwater, Fla. 33515, write: "We hope to make it in '71!" . . . Ruth and **Ralph Wetsten,** 155 West 68th St., New York, N.Y. 10023, continue to enjoy retirement life in the big city. We welcome Ralph's kind words of appreciation for these efforts to keep the class informed of what everyone is doing. . . . **Lewis W. Moss,** 630 Cherry St., Mt. Carmel, Ill. 62863, vehemently protests the report that he couldn't be reached at that address, where he says he has lived for almost 17 years. Lewie adds that a pacemaker took care of a coronary more than a year ago and that he and Mary spent their winter as usual in Pompano Beach, Fla. We're sorry to have disturbed the even tenor of the Moss household but glad it brought the latest news. If you were the one who tried to reach Lewis unsuccessfully, make another effort.

Eugene L. Harlin, 411 Worcester Ave., West Plains, Mo. 65775, broke the sound barrier with the first news we have had in many a year. Gene's welcome letter says, in part: "Little has changed except that I've grown older. Retirement has been very good—sometimes I wonder how I ever found time to make a living. Do you recall you once gave me a job on *The Tech*?" He retired in 1958 from his own contracting business, specializing in highway, bridge and culvert construction, drainage and grading. As if that isn't a switch for a Course VI graduate, Gene says his retirement activities include beef grazing, directorship in two banks and officership in a historical society and a public library association. He and Vesta have no children.

A call from **Jackson W. Kendall,** 401 Hermosa Pl., South Pasadena, Calif. 91030, revealed all is well with him and Marge and they are looking forward to their planned trip to the British Isles this summer. Jack is still active with Bekins Co., Los Angeles, and had been in Seattle on a special research assignment. His work includes attendance at various Interstate Commerce Commission meetings. He anticipates a trip to Honolulu in mid-June for such a meeting.

Thanks to **Robert M. Felsenthal** for taking the time to reply to our recent inquiry. He writes: "It isn't often that you are able to elicit a letter from me but the rumor printed in the February class notes prompted me to drop you a line. I am still active as president of Exmet Corp., 355 Hanover St., Bridgeport, Conn. 06605, which I have headed for the past 22 years. We make expanded metal in very fine forms, chiefly for the manufacturers of special batteries and for other electrochemical uses. Course X shows through even if this is a metal working company. Regards." Bob founded the

firm in 1948 to pioneer in meshes of base and precious metals and heavy duty resistors.

Keenagers on the move

Alfred J. Shaughnessy advises a move from Deerbrook, Wis., back to 501 Aylesbury Rd., Delray Beach, Fla. 33444, and we wish Shag would clear up the mystery as to whether these are respective summer and winter homes. . . . **Herbert A. Kaufmann** gives 41 Banksville Rd., Armonk, N.Y. 10504, as his new home but omits mention of whether he and Mildred still operate their retirement project, the M. and H. Kaufmann, Inc., antique shop in Pound Ridge, N.Y. . . . **Edward I. Mandell** continues as the head of Mandell and Co., 1609 Alton Rd., Miami Beach. . . . **Thomas P. Campbell** has reported a changed home address to Apt. 1427, 90 Corona St., Denver, Col. 80218, and we wonder if this indicates his retirement as vice president and director of Metropolitan Television Co., which operates KOA-TV in Denver. What about it, Tom?

Holland L. Robb, retired U.S. Army colonel, left Chapel Hill, N.C., for a retirement home at 10646 Saratoga Circle, Sun City, Ariz. 85351. . . . **Percival B. Crocker,** who retired as board chairman of the Sentry Co., Foxboro, Mass., says his mail should now go to P.O. Box 398, Foxboro 02035.

William J. Regan, formerly with Swiss Re Corp. in New York City, has retired to a home on Simmons Lane, Greenwich, Conn. 06830. . . . **S. Paul Johnston,** Director of the National Air and Space Museum of the Smithsonian Institution, Washington, D.C. has a new home in Bozman, Md. 21612, where he should be addressed via P.O. Box 191. Wonder if it is in the same tier as P.O. Box 313 for our classmate Daniel P. Barnard, 4th, so Dan and Paul might run into each other at the Bozman Post Office? . . . **Albert J. Hanley,** who formerly made his retirement home in Ohio, has moved to 20 Steere St., Harrisville, R. I. 02830, to be nearer our 50th reunion locale.

Robert F. Miller, 3386 Chiswick Court, Silver Spring, Md. 20906, is still carrying out assignments for the Post Office Dept., although now retired. He and Helen will leave their West Chatham, Mass., summer home early in July for a 48-day European trip, including the Passion Play at Oberammergau. They were in San Juan, St. Thomas and St. Maarten in February but missed seeing Eddie and George Gokey, Jr., there. They report a visit from Marion and George Chutter during the latter's Florida tour. Bob's big news is the arrival on February 19, 1970, of Paul D. Miller to his son Bob, making a total of nine boys and two girls for the Miller grandchildren.

Betty and Assistant Secretary **Sumner Hayward** were hosts to Helen and **Albert E. Fowler** and Maxine and your Secretary at a sumptuous luncheon in the Ramsey Golf Club. Al entertained with vivid recollections of Newburyport and his theater days. We were interested in a clipping from the Newburyport News of February 27, 1970, which reprinted our entire article on Al from the February *Review*. Sumner, **Joe Wenick** and your scribe got together at a dinner and also at a field trip of the M.I.T. Club of Northern New Jersey. Joe has been working on a talk about cost controls for small businesses, which he was asked to present at a seminar in the M.I.T. Alumni Center of New York. He has been paid high compliments in the regret expressed over his retirement from the board of trustees of the library in his home town, Caldwell, N.J. We'll be happy if we can contribute only a fraction of his achievements in our new assignment as a trustee of the Brielle Public Library.

In Memoriam

We have expressed sympathy from '21 to **Donald G. Morse,** 44 Lowell Rd., Wellesley Hills, Mass. 02181, on the passing on March 21, 1970, of his wife, Kim, Wellesley, '22, who attended so many class functions and visited with '21 couples on their frequent trips.

On behalf of the Class, we also extend condolence to the family of **Albert James Kiley,** of 125 Claflin St., Belmont, Mass. 02178, who died on February 4, 1970. Born in Somerville on December 25, 1898, Al Attended Somerville High School. At M.I.T. he was a member of the Mechanical Engineering Society; Technology Athletic Club; Catholic Club, and its secretary; the track, baseball and hockey teams. In World War I, he was a private in the S.A.T.C. He was graduated with us in Course II and spent his entire career with the James A. Kiley Co., Somerville, manufacturers of public utility automotive equipment, of which he had been treasurer. Surviving are his wife, Mrs. Grace E. Kiley; a son, Myles J. Kiley, M.I.T. '55; two daughters, Mrs. Mary Willwerth and Mrs. Agnes G. Heidt; a brother, John T. Kiley, M.I.T. '18, and four grandchildren.

Please!

Make reservations for Homecoming '70 on June 14 and 15 in Cambridge. Plan now for you and your wife to "Join '21 in 'Seventy-one!" Send some news to your secretaries.—**Carole A. Clarke,** Secretary, 608 Union Lane, Brielle, N. J. 08730; **Edwin T. Steffian,** Assistant Secretary, Steffian, Steffian and Bradley, Inc., 19 Temple Place, Boston, Mass. 02111; **Sumner Hayward,** Assistant Secretary, 224 Richards Road, Ridgewood, N. J. 07450

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Your secretary and Dorothy are now editing our memoirs entitled "Africa Visited," while regretfully wastebasketing about 800 of the 1,200 slides returned. These pictures become so near and valuable to us that it's a traumatic experience to dispose of any. However, we must be thoughtful of our friends who will doze fitfully in the dark when the pictures are shown. We report that Africa was wonderful from Ivory Coast through Ghana, South Africa and Kenya. The people were hospitable and the government officials were friendly. As frosting we spent Palm Sunday in Rome and took the Paris flight of the huge 747 to New York.

Oscar Horovitz has just returned from a four-month tour in the Pacific area including Hawaii, Taiwan, Hong Kong, Manila, Singapore, Indonesia and Japan where he visited Expo 70. During the trip he showed the M.I.T. Alumni Clubs his film of the inauguration of Howard Johnson as president of M.I.T. He visited with many classmates including General **C. T. Chien** at Taipei, **J. C. Espinosa** in Manila and **Y. Chatani** in Tokyo. We are told that General Chien has retired from the Republic of China Air Force and is now chairman of the board of Mobil China Allied Chemical Industries, Ltd.

Norman L. Apollonio of Camino, Calif., reminds us that he sat beside **Parke Appel** in many Course II classes about 50 years ago. He will be at the 50th and may travel east with **L. Washington.** . . . **Edward C. Keane,** Vice-President of Fay, Spofford and Thorndike recently appeared on a seminar entitled "Regional Solutions to the Management of Land, Air and Water Use" at the Sheraton in Boston. These programs were aimed at focusing attention on engineering and its accomplishments in accepting the challenge of the '70s to solve the problem of our environment.

Donald R. Waugh of Bridgewater, Conn., has been retained by the Aluminum Association to coordinate its education program. Mr. Waugh, an educational activities consultant to industry, will work with schools, colleges and text book authors. He previously has counselled on educational matters the American Petroleum Institute, the National Builder's Hardware Association and the American Gas Association. In addition he has had 17 years of newspaper experience and was secretary to seven study commissions of the economic subjects. . . . Professor **Kenneth G. Merriam** has retired after a teaching career of 46 years on the Worcester Tech faculty. At the time of his retirement he was the Fuller Professor of Mechanical Engineering. For many years he headed the aeronautical engineering program and was chairman of the college's research committee. Ken spent four years on active duty as an artillery officer during World War II and retired as colonel in the army reserve. He was given the Legion of Merit for his work in anti-aircraft fire control activities. He reports that his retirement is enjoyable, somewhat "free from care" and he is not awed by this computer age. He has corresponded with out classmate Seymour H. Hemenway of Greenwich, Conn.

Cathleen and **William Elmer** have a published opinion regarding the wisdom of lowering the voting age of Americans who have not matured in stability and maturity. They also object to future modern poets and "hippies" entering Congress or participating in the judgments of the higher courts. . . . **Carol L. Young,** Chairman of the Board of

Texas Utilities Company of Abilene, represented the Institute at the inauguration of President J. C. Stevens of Abilene Christian College in February. . . . **Harvey L. Williams** of Philadelphia has been helping American companies with their corporate and operating programs in Europe, Australia and Latin America. He has now accepted the chairmanship of the Centennial Building Committee of Tabor Academy, Marion, Mass. This is to develop a master campus plan for added buildings before the Academy's centennial in 1976.

The sympathy of our Class is extended to the families of **Edward B. Schwamb** of Falmouth, Mass. formerly of Arlington. Edward was a retired mechanical engineer and builder for the Raytheon Co. in Andover. . . . We regret to report the death of **Charles J. Burke** of Skaneateles, N. Y. Mr. Burke was a native of Rochester and resided in White Plains for a good many years. He retired in 1968 as sales engineer for the Cosa Corp. of New York City. . . . Our sympathy is also extended to the families of **Leslie D. Price,** South Harpswell, Maine, **Harold E. Koch,** New York, N.Y., and Dr. **C. Rogers McCullough,** Rockville, Md.

Among the changes of address are George P. Anderson, Hendersonville, N. C., Robert H. Brown, Leominster, Mass., Allen S. King, Delray Beach, Fla., Thomas E. Shepherd, St. Petersburg Beach, Fla., Irving Abrams, Newton, Ma., Valentine Friedrich, Jr., Ormond Beach, Fla.

Ours is a Class in the "near 70" age group to which selected lines from a recent poem apply: "Pamper the body, prod the soul, accept limitations, but play a role. . . . Beware reminiscing except to a child. To forget proper names become reconciled." . . . It all applies to your "eager to serve" Secretary.—**Whitworth Ferguson,** 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz,** Assistant Secretary, 45 Gerard St., Boston, Mass. 02119

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The big news this month is that concerning the most generous gift of Mr. and Mrs. **Cecil H. Green** to M.I.T. of $1.2 million for the establishment of two endowed distinguished chairs. The first will be the Robert R. Shrock Professorship of Earth and Planetary Sciences in honor of Dr. Shrock, former department head who will retire as a professor of geology this June 30. This is the first endowed professorship to be established in the department. The second chair will be called the Cecil H. Green Professorship of Electrical Engineering as was requested by Mrs. Green. Cecil received his S.B. and S.M. degrees in electrical engineering, graduating with our Class. This latest gift comes on top of his previous gift in 1960 of $6 million for the construction of the Cecil and Ida Green Building which houses the departments of Earth and Planetary Sciences and Meteorology. We are truly lucky to have such generous givers on our class rolls!

From **Ida B. Webster** we hear: "I enclose announcement of a new firm, specializing in nursing homes and housing for the aging. Continuing public housing projects and I am secretary of the Citizens Housing and Planning Council. I am also chairman of the New York Chapter A.I.A. Speakers Bureau. . . . My son is associate professor of history at Berkeley and my daughter lives in Westport, Conn.,—nine grandchildren." The firm is that of Weiss, Whelan, Edelbaum and Webster of New York. . . . From the Elsevier Publishing Co., of New York, we hear that our classmate, **Nathaniel Robinson** has written a book, *Solar Radiation,* published in 1966.

We are most sorry to be obliged to report the deaths of two classmates: **Manuel M. Delugach** passed away on February 11, 1970, and **Joseph Nissen** on March 8 of this year.

The following were in motion during February and March: Emil S. Birkenwald, Apt. 5-3, 4011 Roswell Rd., N.E. Atlanta, Ga., 30305; Erwin G. Schoeffel, 148 Wilson Hill, Massena, N.Y., 13662; Jerome A. Watrous, 80 Barrett St., Northampton, Mass., 01060; William Webster, New England Electric System, 4390 Prudential Tower Bldg., Boston, Mass., 02199.—**Thomas E. Rounds,** Secretary-Treasurer, 4 Deer Hill Drive, Danbury, Conn., 06810

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Inevitably, **Luis Ferré** continues to make headlines. Clippings pour in from the Gary *Post-Tribune,* "Northwest Indiana's Leading Newspaper," the Trenton *Sunday Times Advertiser,* the *Boston Globe,* and many more. From these it appears that Puerto Rico is, basically, no different from the mainland. It has its full share of such ills as student unrest, pollution, and unemployment, but Luis has not forgotten his major objective, statehood. A lengthy *Wall Street Journal* article starts off with this ringing gubernatorial quote: "Forward! United in the great task of making a reality of the dream which nests in the heart of every Puerto Rican." You know that doesn't sound a bit like the lad I used to do experiments with in PEE lab! Wonder if he's decided where to put that 51st star?

The smash climax of the 1970 Mexican Fiesta was held once again in the **Nish Cornish**'s beautiful garden. The only '24 attendees from the States were Dot and **Paul Blampied,** put "locals" included Gerry and **Jack Nevin** and **Ru Torres-Saravia.** This report came from Warren Henderson, '33 Secretary, who added, "Wish there were more, but Cornish is a whole platoon by himself." Since Nish has been the moving spirit behind these affairs from the beginning (this was the 22nd!), he is entitled to every designation from el Presidante or Generalissimo on up and down.

The **G. Raymond Lehrer**'s travels took them from Thailand into Cambodia, and while they were busily inspecting temples things began to happen. One day when they were supposed to go hopping off for a bit of sightseeing, they were told that the Pnom Penh airfield was closed "because of the arrival home of the king returning from Peking." As they soon discovered, the king was having his own troubles, but finally, four days later, "after a long, hard eight-hour bus drive to get out of the country", they made it back to Thailand. From there things got better fast, and the latest word was from Hiroshima as their trip was drawing to a close.

By this time **J. Earl Frazier** should be well launched into his term as president of the American Ceramic Society. An advance release said that the 72nd annual meeting was to be held in Philadelphia May 2-7, and at the Inaugural Session on May 4, Dr. Frazier was to be installed as head of "an organization of more than 10,000 ceramists in 58 countries—the world's largest society devoted to the advancement of ceramic science and technology."

Russ Ambach responded to your Secretary's plea for interim holiday greetings with a "Happy Easter" letter. Russ added the news that he and Ethel joined the parade of 40th anniversary celebrants last December with a major blowout at Boston's Ritz Carlton. There were 22 guests in all, gathered from all over. Highlight of the occasion was the reading of an original Russ Ambach poem; a psuedo-clerihew. He will never be voted poet-laureate of the Class, but no one other than a first-rate engineer could possibly have compressed 40 years of married life into 15 quatrains. All the essential data were there, and he even worked in Ethel's broken wrists (February, 1953), and the time they went to see *South Pacific.* Quite a feat.

REMEMBER THE YEAR? It was the year two wealthy college students went on trial for the thrill murder of a 14-year-old boy. The same year also brought the deaths of Lenin and Woodrow Wilson. The Prince of Wales paid a visit to America during which he charmed the ladies, played squash, and joined a fox hunt on Long Island. Also from England came the first broadcast to be heard in East Coast cities. In sports, swimmer Johnny Weismuller, who was never beaten in any free-style race from 100 yards to half-a-mile, set a world record for the 100 meters at the Olympic Games; and Red Grange and the Four Horsemen of Notre Dame dominated football. On the economic scene, Americans were concerned about the upsurge in credit buying, Ford made his 10-millionth car, and some people worried about the heavy turnover in stocks following Calvin Coolidge's election. It was the year we graduated, 1924.

Two of our graduate student classmates died recently, **Ernst A. Guillemin,** M.I.T. Professor of Electrical Communications, Emeritus, and **Herbert Duthie,** Commander, USN Ret. Unfortunately we also

have word of the deaths of Mrs. Blanchard D. Warren and Mrs. Luis A. Ferré. Mrs. Ferré had been largely bed-ridden for the past decade. During all his years of political campaigning, Luis made every effort to return home each night, no matter what the hour, and he usually succeeded. To the families of all, the sincere sympathies of the Class.—**Henry B. Kane,** Secretary, Box 177, Lincoln Center, Mass. 01773

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A recent letter from **Robert B. O'Hara** answered a question raised in a recent issue of the *Review.* Bob retired to 1865 79th Street Causeway, North Bay Village, Fla., in 1967. He most interestingly pointed out that in thinking about profits and losses, he about decided that he was a financial failure until he began to realize what a fine job he had done in bringing up two fine children, a boy and a girl. His son had decided just what he wanted to do while still in high school. He found by taking certain tests that he was without any question officer candidate material for the United States Coast Guard, so he immediately went on to Kings Point Academy, graduated in the upper 10 per cent of his class, and went on into the United States Navy. Now, at the age of 32, he has been a lieutenant commander for two years, and has received two citations from the commander in chief of the submarine fleet. He so nicely refers to his daughter as the "Irish girl who received the ten talents, as quoted in the Bible, and she juggles them all!" Beyond that, Bob can only say that he is enjoying his retirement at the 72nd Street playground at Miami Beach, playing shuffleboard and chess with the best of them. He issued an invitation to any members of the Class of 1925 to drop in on him if they are in the South.

Another letter from the South came in from **T. M. Lowe** who can be reached at Thomas M. Lowe, Jr. and Associates, Inc., 1920 Monroe Drive, N. E., Atlanta, Ga.

Warren Henderson, Secretary of the Class of 1933, was most thoughtful in informing your Secretary that Connie and **Malcolm Blake** as well as Dorothy and **John Campbell** attended the Mexico City M.I.T. Club Fiesta in March of 1970. I have just learned also that President Sam Spiker and his wife had been in Mexico City on vacation but missed the Fiesta. They returned to Westport, Conn. via the West Coast.

I have also learned that **Garvin "Chink" Drew** recently had an operation for cataracts but is coming along very well, and we are looking forward to his providing us with fine entertainment at the 45th reunion.

As most of you are aware, **Will Gardiner** has been collecting statistics for the reunion and received a letter from **Edward M. Lee** in Silver Spring, Md., which noted that **Richard T. Perry** is located in Burlingame, Calif., working for the Public Utilities Commission of California.

I am sorry to report the death of Colonel **Garland T. Rowland,** U.S. Army (Retired) at Middleburg, N.C. on November 28, 1969. Colonel Rowland was one of many military personnel attached to the Class of 1925 who spent a short time at the Institute with our Class.—**F. L. Foster,** Secretary, Room 4-144, M.I.T., Cambridge, Mass. 02139

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A recent letter from **William A. Cook**'s wife tells of Bill's sudden death last November. Bill graduated with those of us who were in Course XV and spent his life in the leather industry. I used to visit him first at his father's tannery and later at the A.C. Lawrence Co. in Peabody, Mass. I have extended the sympathy of the Class to Mrs. Cook. It was interesting that Mrs. Cook should comment in her letter that she read the '26 notes regularly to keep posted on activities in Pigeon Cove. All we need is a bit of encouragement to keep on feeding you the local gossip rather than report all the class news as we are supposed to do.

It seems unbelievable that when these notes reach you it will have been four years since five Greyhound buses of "twenty-six" classmates rolled into Pigeon Cove. We never will remember exactly which classmates were here. You kept me so busy filling the punch bowl that I failed to keep a record, but it remains the party of a lifetime for us—an experience we often relive. Also, about the time you read this Ruth and I will be having our 40th wedding anniversary. She doesn't know it yet but I'm hoping to retrace our wedding tour which started north through Maine to Quebec City in a brand new but not too reliable Essex Coupe. I blew about half our trip budget on a tower room at the Chateau Frontenac (two nights) and remembering the sage advice of classmate and roommate **William Ebling Peter Doelger,** I decided to make a purchase at the government liquor store immediately upon arrival in Quebec (prohibition was in full bloom at home). "Pete" had always told me that the best liquor in the world was called "Benedictine." Being completely unsophisticated, and wanting the best on my wedding trip I said, "Give me a quart of Benedictine," took it up to the tower room and gurgled out two water tumblers full. Ruth took one sip and said, "I can't drink that stuff." I insisted that Pete said that there was no better "likker." Then I sipped, and poured both tumblers back into the jug. A glass of sherry before dinner proved more palatable. We lugged the jug in the back of the Essex and stopped to see another classmate at Farnham, P.Q., one **Willard Everett Vaughan** who accepted the Benedictine in trade for a bottle of Bass's ale and explained the difference between liqueur and liquor. If we make the planned tour we hope to see classmate **Louis Berube** who came down from Quebec to our 25th reunion to claim the largest family up to that time.

A recent letter from **George Edmonds** really made an impression. For many years I kept a checking account at the Wilmington Trust Co. but since retiring from duPont found it no longer necessary and closed it. Believe it or not George noticed this and wrote me. George has retired from the bank but still follows the opened and closed account list, a bit of detail that must set an example throughout the bank and without fanfare let the customers know that it is a personal institution, interested in them. George continues to be active in M.I.T. affairs, is a member of the Corporation and chairman of the Visiting Committee, Department of Nutrition and Food Sciences.

Some time ago **Win Russell** reported that **Richard Sherman** had retired on the "Coast of Maine" and that he had bought nearby. I must have asked for more detail since Win has written that it is East Boothbay and that Dick's place is a mid-eighteenth century house now completely restored in Meadow Cove on the Damariscotta River. Win's place, circa 1800 but now modernized, is on Ocean Point Rd. (Rt. 96) near the village center and Win reports the latchstring is out.

Chet Buckley wrote a real newsy letter recently that we can quote verbatim: "Dear George: When we read of so many of our classmates who are retiring, it is interesting to hear of one who is assuming extra responsibilities. **Clint Galphin** has been named President of the L. E. Wooten Company, Consulting Engineers of Raleigh, N.C. 'C.B.' was our star tumbler on the M.I.T. gym team and since graduation, has spent his years consulting in the Carolinas. He still keeps in fine shape with regular gymnastic exercises and reports that he hopes to attend the next class reunion. For the past several years, we have called on Mable and **Nat Gada** when in Florida. Nat took an early retirement from General Electric and finds Florida winters less harsh on his health.

"In December **Jim Killian** addressed some of the M.I.T. groups in Chicago. Jim brought us up to date on the recent activities in Cambridge, which make the life of educators more challenging and more exciting than they used to be. The group agreed at the meeting that the situation at M.I.T. was in good hands and that the administration deserved the favorable comments in *Time* magazine. Jim, **John Wills** and I had a chance to observe that this is the big year for retirement for the members of our Class. It also reminded me that the Class of 1926 has been prominent in the M.I.T. Club of Chicago. In 1962, John Wills was president of the M.I.T. Club of Chicago and he was succeeded by Bruce Humphreville the following year. As you know, Bruce passed away just before our last reunion. **Dwight Taylor** was chairman of the Educational Council for this area until his recent retirement and return to New Hampshire." Chet says nothing about retirement plans

and his American Gage and Machine Co. (Chicago). His stationery still bears the word president, and the names of seven subsidiaries appear at the bottom of the page.

We mentioned our 45th reunion recently and now it is only a year away. The Belmont at Harwichport was reserved when we left there at our 40th and the reservation appears to be in good order. More on this next month and Cheerio until July. —**George Warren Smith,** Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

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Fordyce Coburn, whose last job was director of purchases for C. F. & I. Steel Co., Pueblo, Colo., has retired after 25 years with that company. Dyce joined the Wisconsin Steel Division of International Harvester after graduation, and in 1944 moved to E. & G. Brooke Iron Co. and the Richard Ore Co. as vice-president of both companies. When these companies were merged into C. F. & I. in 1952, he became district manager for the Brooke plant and the Richards mine. He became director of purchases for the parent company in 1961.

The April notes recorded that **John C. Parker** had delivered an address on New England ghost houses to a group of more than 400 at Westfield, Mass. Now I have word that he addressed a similar group on the same subject in Manchester, Conn., in January. It is a fascinating subject, and I would guess he can find as many audiences as he has time for.

Leroy G. Miller has returned to this country after a year in Liberia, West Africa, as maintenance engineer for the Lutheran Church's senior high school in that country. . . . **Percy L. Richardson,** who is retired, spent the winter at Venice, Fla., and by the time these notes are printed will be back in East Andover, N. H. . . . **Stuart Bugbee** retired at the end of April. He was expecting to "estivate" in Maine from June through September, and had no plans beyond that.

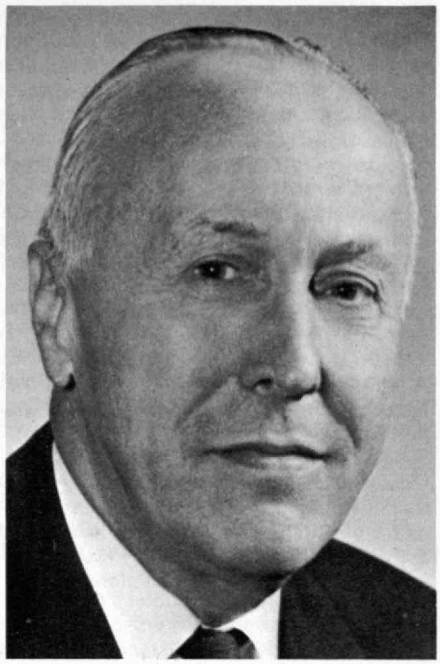
Joe Harris continues the journal of his trip on a slow boat to China: "Since I wrote last, I found that we had on board an old friend of Betty and **Bill Payne**'s—Mrs. Lloyd Brannan of Denver, who had formerly lived in Dayton, Ohio. She couldn't have said more flattering things about them, but she did report that Bill has been ill.

"We made a two-day stop at Seoul to unload cotton. The port city of Inchon (where MacArthur made his famous landing despite 30-foot tides) is quite undeveloped except for a large U.S. Army warehouse complex, but leading from it to Seoul is a surprising toll superhighway, flanked by rice paddies and much small industry . . . Seoul is humming with activity. It is a pleasant place; the downtown area sports skyscrapers up to 20 stories, but it also has wide plazas and several long pedestrian underpasses, some lined with attractive stores. The young men from the offices looked for all the world like their New York counterparts, with white shirts, black suits and ties, and attaché cases. G.I.'s were conspicuous by their absence.

"Taipei, in the Republic of China (Taiwan), on the other hand, was full of G.I.'s who were there on R. & R. Again, we landed at a port city, Keelung, en route to the capital, Taipei. Keelung has over 300 rainy days a year, and this was one of them. Our military assistance program keeps a good many Americans in Taiwan, in addition to the G.I.'s. The National Palace Museum contains so many of the great treasures of Chinese art that only a small part can be displayed at any one time, but we feasted our eyes on hundreds of priceless items. The Grand Hotel (owned by Mme. Chiang), with its traditional Chinese architecture and decor, is considered among the world's most beautiful hotels, and so it looked to us.

"Our next stop was Hong Kong, and we arrived at dusk. All 60 of us passengers stood on the deck as we approached, and we ran out of adjectives for its staggering beauty. Here our ship went into drydock for 12 days. Much the most pleasant event in Hong King was finding our classmate, **Wally Kwok,** who lives here and is distributor for Parker pens in this part of the world. Having a chance to meet some business people, I was most interested to hear them refer to Walter as 'Mr. Hong Kong', and there seems to be more than a grain of truth in it. Wally's hospitality was generous and thoughtful, and he urges other classmates visiting Hong Kong to call on him. . . . We will be back in Japan to see Expo 70 on the way home. The trip has been great, and so will getting home be."

James T. Chirurg died on February 9. His business career had been entirely in advertising, in which he had been most successful. His home was at 15 Winthrop St., Danvers, Mass. Born in Boston, he attended Newton High School and obtained his first degree at M.I.T. in naval architecture. Then, after attending Harvard Graduate School of Business, he received a master's degree in engineering administration at M.I.T. After working in the advertising department of the Foxboro Company, in 1933, Jim took $1000 of his hard-earned money and hung out his own advertising agency shingle. Calling from door to door, he signed up his first accounts. He became chairman of the board of James Thomas Chirurg Co. of Boston and of Ciango Mehlich C & C Inc. of New York City, which serviced many name-brand concerns. During World War II he was asked by the British government to study the incentive methods in their war plants. In 1948 he served on the governor's Council for Oil Conservation and in 1951, he authored "So You're Going to Choose an Advertising Agency," published by *Printers' Ink Magazine.* He has been the donor of annual fellowships at Harvard Graduate School of Business given each year to an



James T. Chirurg, '27

outstanding student seeking a career in advertising. Jim is listed in *Who's Who in America* and *Who's Who in the World.*

From 1957 to 1962, he served as chairman of the industrial commission of Danvers and in 1960, as a member of the Department of Commerce trade mission to the United Arab Republic. These are just a few of the evidences of Jim's active and useful life.

We have had word of the death of **Jesse G. Nash** on January 5. A graduate in civil engineering, his business career was entirely in heavy construction, mostly concrete and steel bridges, including work with the Austin Bridge Co. of Dallas, Texas. Ten years ago, at the age of 65, Jesse retired and he and his wife bought an Airstream travel trailer. They were in the north two months in the summer, went to Mexico or Florida in the winter, and spent the balance of the year at their home on the shore of Lake Belton in Texas. Jesse was very fond of this location and wrote of its beauty. His address was R.D.#1 Belton, Texas.

Once again, I find that Joe Harris has made things easy for me by writing most of the notes in absentia. He will be back in time to write the next ones himself. I have enjoyed substituting for him, but I'm glad he's back.—**Joseph H. Melhado,** Acting Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

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In March we learned that **Paul Johnson** had come all the way east from Hawaii to undergo operations on both hips at the New England Baptist Hospital. **Jack Chamberlain** visited Paul at the hospital. Later, and just after one of the operations, **Jim Donovan** talked with Paul by telephone. Jim reported that Paul

sounded real chipper and was anxious to be up and about right away.

At nearly the same time Trudy and **Don Francis** were back in Rochester for a similar purpose. Don also had to have some surgery done. Apparently he came through in good fashion and returned to Florida and at last report he seemed to be pretty well recovered. . . . A short note from **Richard B. Goble** says that he has just retired and will be living in Kilmarnock, Va. along with classmate **Fred Riley.**

A letter from Italy advises that **Herman F. Krantz** was awarded an honorary decoration by Mr. Giuseppe Saragat, President of the Italian Republic. The title, "Great Officer of the Order of Merit of the Italian Republic" was bestowed in recognition of outstanding industrial and social activities in Italy. Herman is President and General Manager of Stigler-Otis S.p.A. in Milano, Italy.

Max Alimansky will represent the Institute at the inauguration of the President of North Adams State College on May 2, 1970. . . . Certificates of Appreciation were awarded to 90 alumni for outstanding effort in the 1969 Alumni Fund. We are pleased to know that **Arnold A.** ("Arch") **Archibald** was one of those so recognized. He served as Special Gifts Area Chairman in Pittsburgh, Pa.

Frannie and **Jim Donovan** have had the happy experience of a wedding in the family. On April 4, Marcia Bugala became the bride of Andrew, the Donovans' older son. Marcia, a very energetic girl, is a graduate of Ohio University. She has taught school in the elementary grades in Cleveland, Ohio and in Newton, Mass. In addition to teaching she has been a hostess for Northeast Airlines. Andrew studied at Browne and Nichols School in Cambridge then at Northeastern University where he specialized in electronics, his professional field. The young Donovans have bought a home in West Somerville, Mass., and are busy making it over to suit their own tastes and needs.

Through Jim we learn that Gladys and **Dave Olken** have just returned from a trip to the Far East. They are highly enthusiastic about their stay in Hong Kong. We should get a more detailed account of their travels from Gladys or Dave. . . . Jim also reports that he visited briefly with Priscilla and **Roger Haven** one evening recently. They have a beautiful spacious home where Roger delights in building things. His creations range from several extraordinary and attractive clocks to a real beauty of an iceboat. The iceboat gets used—in fact, Roger went through the ice on one occasion and found it a chilling experience.

Many of you will remember **Charlie Haberstroh.** Almost directly after graduation Charlie went to work as a chemist for Lever Brothers Co. in Cambridge. Except for an interruption during the World War II years he continued this association until the company moved to New York. During the war he worked on large-scale field tests at Dugway Proving Grounds in Utah for the Army Chemical Service. He left the army with the rank of Major. More recently Charlie has served as a government inspection officer working out of the Boston Army Base. When this unit moved to New York City Charlie went along although retaining his home in Boston. In this way he commuted for several years. Finally he was working out of Philadelphia, still with his home in Boston. Since April of 1968 Charlie has been retired to a life of gardening, some consulting, and a fair amount of traveling.

Charlie and Stasia (Anastasia) spend some of their time driving to Washington, D. C. or to Mississippi to visit with married sons. The oldest son, John, studied economics at Boston University then won his master's degree at Tufts' Fletcher School of Diplomacy. Now he is employed in government service and just completing requirements for his doctor's degree. The second son, Paul, is in the air force and he is the one based in Mississippi. Philip, the youngest, will graduate from Massachusetts State University this year. He has specialized in mathematics and intends to be come a teacher. First, however, he will have to meet his military service obligation. All five of the Haberstroh grandchildren are due to daughter Jane (Mrs. Dennis Pattengill) the oldest of Charlie's children. Last year Charlie went to the British Isles by steamer and toured Scotland, England, and Ireland by rail. It was a most restful trip. Charlie was much impressed by the quiet ancient beauty of the countries visited and by the cordial and courteous treatment he received everywhere.

Another vigorous note from **Bill Hurst** denounces the prevalent idea that old engineers are obsolete. He is firm in his stand that we received at the Institute in our day an excellent education in fundamentals and that the foundation so built is as sound and serviceable as ever. Many of us still active professionally can agree. Certainly in Bill's case there is no room for argument!—**Walter J. Smith,** Secretary, 209 Waverly St., Arlington, Mass. 02174

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When I left Florida on April 15, **Hugh Hamilton,** whose illness was reported last month, had sufficiently recovered to be able to return home to Durham this summer as usual.

Frank Mead, in cooperation with **Wally Gale,** has made arrangements to have our informal 41st reunion at Bald Peak in New Hampshire where we had our 35th. We will report the details in the next issue of the *Review.*

The following twenty-niners attended the recent Mexico City Club Fiesta: **Oscar Aros Villa, Leon Avalos Ves,** and **Salvador Madero, Jr.,** all of Mexico.

I received a letter from **John F. Dreyer** as follows: "Dear Karnig: We owe a vote of thanks to you secretaries who take on the class notes. This work is appreciated. I didn't make the 40th reunion. It would have been fun to see if anyone was still recognizable—Paul Donahue for one—I wonder what he has been doing. Glad to hear Warren Walker is still active. I vote for Florida for the next reunion. My excuse for not being at the reunion was a trip to France to give a paper at a Liquid Crystal Symposium. Should any of you be interested in the subject, I would like to hear from you. I still enjoy research but have to spend most of my time running to Polacoat, Inc. We make rear projection screens and light polarization filters. Have enjoyed world traveling for vacations. Am looking forward to doing more research when I retire."

Gustav A. Stein, Jr., writes: "My studies were interrupted for eight years in 1927 until I graduated in 1937 to the applause of a wife and two children. All my career from 1927 has been with Standard Oil Co. of New Jersey and its subsidiaries. After a year's training program in the many functions of the company, I was in Denmark for two years in a technical advisory position. Then 23 years in Baton Rouge, La., in the development field of hydrogenation, fluid catalytic cracking, and early petrochemical ventures; in starting and operating petroleum and chemical plants. My last 11 years were spent in overseas service starting a fluid hydroformer in Venezuela, making a refinery in Belgium, building one in Norway, and finally serving as chief executive officer of our Danish affiliate." Gus has retired and lives in Florida with his wife Ruth.

Charles W. Denny, Jr., reports that he is presently vice president of Square "D" Co., manager of the Middleton plant. Upon graduation he was associated with Westinghouse in Pittsburgh. In 1932, he changed his affiliation to Barkelew Electric Manufacturing Co., and became its president in 1956 until the company was acquired by the Square "D" Co. in 1967. Charles and his wife Lucille, who were married in 1934 have two children and six grandchildren. They have had Evelyn and **Brig Allen** as overnight guests at their home in Middletown, Ohio.

Harry E. Shoemaker has retired and lives in Arcadia, Calif. with his wife Victoria. Upon graduation, Harry worked for one year as draftsman for Coolidge, Shepley, Bulfinch and Abbot, a well-known architectural firm in Boston. He moved to the West Coast where he worked for a number of firms in his field. He has three happily married daughters and his interests include photography and trailer traveling. He is also secretary of the Pasadena area Fellowship of Christian Athletes. He says, "Some of my most cherished years were spent at M.I.T."

A note comes from **Laurence R. Moses** who lives in Delmar with his wife Kay. He is connected with the N.Y. Telephone Co. in Albany as plant supervisor. He writes: "Happily married nearly 37 years. Have

two sons, 30 and 33, both married, and a daughter graduating from Syracuse University this June and expecting to teach high school English. Served in the army signal corps in W.W.II for over five years on radar work. Last active army job as base signal officer, Newfoundland Base Command at St. Johns, retiring recently with a rank of lieutenant colonel. I am completing 40 years of service with the telephone company in August. I have gone on camping trips locally and across country as the children were growing up. Visited son Larry in West Berlin in 1962 and toured 11 countries with them. Life has been good to us in health, happiness and satisfaction."

Robert S. Riley of Middlebury, Conn., writes, "In June 1929, I went to the U.S. Army Air Corps Flying School and received my pilot's license the following year. Worked at Pratt and Whitney Aircraft from 1930 to 1946 as test engineer, project engineer, and assistant eastern field engineer. Married Katherine Lilly in 1931, having four children and ten grandchildren. Having been divorced in 1965, I remarried Margaret Allen Kellog who had three children, making a family grouping of seven children and 18 grandchildren. Since 1953, I have been working for Engineered Sinterings and Plastics, Inc., presently as chief engineer and director. I went around the word in the fall of 1968 and visited my stepson in Australia. My hobbies include sailing and skiing, having just returned from 10 days of skiing at Aspen, Colo."

I deeply regret to announce the death of **George J. Burke**'s wife Ruth which occurred on February 3, 1970 aboard the liner *Gripsholm* at Lima, Peru, while they were on a trip around South America. George writes in his note that his two daughters-in-law, Ann and Jane, and seven-grandchildren have been of great help and comfort to him in his hour of sorrow.

In the April issue of the *Review,* through an error of mistaken identity, George was credited with being connected with EMR-Computer as regional sales manager. Actually, George has been for many years the president of the Burke Corporation, general contractors in Salem, Mass. My apologies for the error.

Please note changes of address for the following classmates: Devereaux Martin, 1147 Belmont St., Manchester, N.H. 03104; Walter W. Schormann, Ashland Rd., Summit, N.J. 07901; George G. Kirkpatrick, Drawer K, Gainsville, Fla. 32601; Edward M. Tillman, 160 E. 65th St., New York, N.Y. 10021; Paul V. Keyser, Jr., Divinity Hill, Shelter Island Heights, N.Y.

I would like to hear from more of you fellows. My backlog of news items has reached a new low. Please write, even if it is a post card, telling us how you are. Your classmates would like to know. Hope to see some of you at Bald Peak for our 41st reunion. Kindest regards.— **Karnig S. Dinjian,** Secretary, 32 Oldham Rd., Arlington, Mass. 02174

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By the time these notes reach you our 40th reunion will be history. Jack Latham reports that the reservations continue to roll in and that the attendance is likely to be the largest of any of our reunions. For those unable to attend I hope to provide a fairly full report of the proceedings in the first issue next fall.

Most of the material at hand this month is concerned with retirements. Of the five retirees from and of whom we have heard, two are planning to go into teaching. . . . **Winslow Hartford** retired in November 1969 from Allied Chemical Corp. and has since been doing some consulting work with a "moderate clientele." He is planning to teach at Carolina Piedmont College next fall. . . . **Jim Biggane** will retire as administrative manager of manufacturing for the Maytag Company in August 1970 and is planning to join the faculty of the University of North Carolina at Raleigh. Jim joined Maytag in 1945, organizing and heading the industrial engineering department, then moving on to manager of manufacturing. He served as chairman of the National Industrial Conference Board in 1962 and is a member of the Management Council of the American Institute of Industrial Engineers and the National Society of Professional Engineers. He has also served on staffs for management training programs at the University of Iowa and the University of California. . . . **Hugh Wallace** has retired as president of the Watsonville Press in Watsonville, Calif., but didn't give any details as to his retirement activities.

As of December 1969, **Henry Pattison** retired from Benton & Bowles where he was chairman of the executive committee. He is living in Tucson, Ariz., and enjoying a life of leisure after 41 years in the advertising business. The Pattisons have four children: Bill, who is vice president of Ogilvey, Benson & Mather; Peter, who is a vice president of Uris Corp.; Michael who is with Spencer Trask in the stock market; and Bob, who is finishing his Ph.D. at Columbia. In addition there are some ten grandchildren who visit Tucson from time to time. Pat's main hobby is still amateur radio. He recently had an article in *QST* on a new integrated circuit frequency standard which brought in over 500 letters, all of which had to be answered. Pat says that actually he is busier than he was at the office and has to "get up early because I have so much loafing to do."

In October 1969, **Ed Nolan** retired from Merck & Co. as director of quality control. He sent in a gratifyingly full account of his past and present activities, but unfortunately because of space limitations only the highlights can be reported. His work at Merck was generally production oriented and he was directly involved in the initial production of many important drugs including vitamin B-1, riboflavin, atabrine (W.W. II anti-malarial) streptomycin, penicillin, cortisone, vitamin C, vitamin B-4 and a number of other successful Merck specialty drug compounds. His non-business activities included president of the Rahway Kiwanis Club, board member of the Elizabeth, N.J., Junior Achievement, board member of the Eastern Union County Chamber of Commerce, member of the executive committee of the New Jersey Taxpayers Association and chairman of the local Hospital Fund Drive. He and Irene have bought a condominium in Pompano, Fla., "located on a golf course" and plan to spend the winter months there. The Nolans have four children: Ed, Jr., who is sales manager for Seagram in Indianapolis; Nancy, whose husband is M.I.T. '65 and works for Corning Glass; Robert, who works for Atlantic Richfield in the research department; and Amy, who is a student at Newton College of the Sacred Heart. Ed says he sees **Phil Holt** occasionally on the golf course at Canoe Brook Country Club.

This month's kudos go to **Jack Latham** for receiving the "Engineer of the Year" award from the Engineering Societies of New England. The award was presented at the 1970 Engineers' Week Luncheon at the Sheraton Boston on February 26. . . . Warren Henderson, Secretary of '33, was kind enough to pass along the information that **Emilio** "Maco" **MacKinney** attended the M.I.T. Mexico City Club Fiesta this year, apparently the only classmate to attend.

It is regretfully necessary to report the deaths of three more of our classmates. **George Shaw** died on March 12, 1970, after a long illness. During the last few months of his life he told his wife a number of times that he would have liked to have made the 40th reunion. The Shaws lived in Woburn, Mass.

De Wolf Thompson died in December, 1967, of lymphoma. He was owner and manager of the Menemsha Inn on Martha's Vineyard which Mrs. Thompson has continued to operate.

Herford Southwood died on August 19, 1968. Unfortunately I do not have any information in my records about him.

Changes of address: Elroy Webber, Trum Rd., Athens, Ohio 45701; George G. Perry, 6913 W. 51st St., Shawnee Mission, Kansas 66202; Paul R. Konz, 7575 Bellaire Rd., Houston, Texas 77036.— **Gordon K. Lister,** Secretary, 530 Fifth Ave., New York, N.Y. 10036

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Dr. **Isaac H. Schwartz,** of South Dartmouth, Mass., died unexpectedly on March 20, 1970. Dr. Schwartz was Chief of the Department of Pediatrics and the Department of Electro-encephalography at St. Lukes Hospital in New Bedford. He served on the executive board at the hospital and was engaged in numerous civic activities. He maintained an active interest in M.I.T., serving as a former president of the M.I.T. Club of New Bedford and as educational advisor for the

area to the Educational Council of M.I.T. After receiving his S.B. degree at M.I.T. in 1932 he attended the University of Bonn, Germany and received his M.D. degree at the University of Basle, Switzerland. He spent two years in research work at the Hebrew University in Palestine and returned to work in pediatrics at Boston City Hospital before taking internship at St. Luke's Hospital in New Bedford. He served in the Navy during World War II from 1942 to 1946 in the Pacific Theater and was a member of the local naval reserve unit until 1967. His dedication to the care of children and to many professional activities and his contributions of time and service to the community were outstanding over a period of many years.

Howard A. Kinzer, Course I, retired four years ago from the Burlington Railroad as Chief of Right of Way in West Virginia. He and his wife live in McLean, Va., and he now teaches tax preparation to H. R. Block Company employees. Howard and his wife took a trip around the world two years ago and are planning to tour Europe this spring. They have two married children and two grandchildren.

Colonel **J. Paul Breden,** Course II, retired in 1958 from Army Ordnance and until recently headed the Landon School for Boys in the Washington, D.C. area where he and his wife reside. They take an annual trip to California, where they have a married daughter, or to Florida where their married son is an electronics engineer. Four grandchildren are also reasons for the trip. Paul's hobbies include photography, woodworking and genealogy. . . . **Neil A. Connor,** who took his master's degree in architecture with our Class, is now taking a trial retirement for one year from the government where he has been director of architectural standards and chief architect for the Federal Housing Authority in Washington, D.C. He also is a retired Commander in the U.S. Naval Reserve. Neil is a bachelor and after relaxing for a time on Cape Cod has now chosen a home site on Antigua in the Caribbean. He is an accomplished sailboat operator and plays golf wherever he goes.

Robert W. West, Course I, is retired from the Army Map Service where he last worked on relief maps. Every summer he and his wife take his 92-year-old mother to their summer place in Maine. Robert is a devout churchman and sings bass in the choir; he also plays the banjo and guitar (no rock and roll). His wife maintains a career with the American Association of School Administration which requires that she travel around the U.S. as a convention coordinator.

Donald A. Rice, of Silver Springs, Md., is in the U.S. Coast and Geodetic Survey, having been in the government civil service since graduation. He and his wife have three sons, the oldest a civil engineer, the second with the Suburban Sanitary Commission in Washington, D.C. and the youngest still in college. Donald travels frequently to Europe for meetings in connection with his geodetic survey work. His hobby is a 30-foot sailboat with a motor.

H. Kelsea Moore, Course XV, has been working since 1938 in the firm of Eaton and Howard, Inc., Boston, Mass. He plans to retire in October, 1970 and go out to Sun City, Ariz. . . . **Carl W. Ziegler,** Course X, whose address is Edgar Pol 221, Mexico DF Mexico attended the recent M.I.T. Mexico City Fiesta with his wife, Livia.

Dr. **Howard M. Quigley** who took architectural engineering at the Institute became dedicated to the education of the deaf soon after 1932. He acquired his M.D. degree in the mid-1930s and for nearly 30 years was superintendent of schools for the deaf in Iowa, Kansas, and Minnesota. He is now occupied with the distribution of audio-visual materials for the deaf in Washington, D.C. Howard is active in Rotary, having been a district governer and participates in the D.C. Symphony. He and his wife are planning a visit to England in September 1970 and a trip to Hawaii in early 1971. . . . Major General **Thomas A. Lane,** U.S. Army Retired, of McLean, Va., has written three books in the last several years on the U.S. security posture in the world. He currently produces the syndicated column "Public Affairs" for Columbia Features. His distinguished military career included engineer commissioner for Washington, D.C. and president of the Mississippi River Commission. General Lane is also a past president of the American Institute for Constitutional Action.

Frank W. Burwen of 84 Flint St., Salem, Mass., died on January 12, 1970 after a brief illness. He had been a partner in the Duro Manufacturing Co. of Lynn since 1935. He was a nationally known photographer and member of the Lynn and Boston Camera Clubs. He was also a competitive pistol marksman and a member of the Woodend Rifle Club of Swampscott. He was also a member of the choral groups of Temple Beth El in Swampscott.—**Elwood W. Schafer,** Secretary, Room 13-2145, M.I.T., Cambridge, Mass. 023139; **James Harper,** Assistant Secretary, 2700 So. Grant St., Arlington, Va. 22202

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Well, Sir, the time again rolls around for us to grind out the class news, and with little material with which to work, which is in some ways slightly degrading, as it turns out that most of the material is in reply to cards and letters of mine. However, the show must continue, so this time we open with an old and true and long-time friend, **Joel Stevens,** of Kingsport, Tenn. From him this time, we have a very pretty post card captioned "Alter of the Fatherland" (Vaterlandalter). I have never been too sure of how they got those horses, and chariots up on that pair of roofs; it really took heroic measures to do all that lifting. Joel proceeds as follows, "Elizabeth and I arrived in London, in October, on business for T. E. C. (Tennessee Eastman Company). Work proceeded from then until not too long ago, when we decided to go to Rome, and thence to the U.S.A." However, it turns out that the Stevens took time out over Christmas and New Year's to visit the beautiful lake district of England with "T. E. C. and London friends, for the fine holiday festivities." So they spent a week in Rome, and supposedly, they are now in Tennessee. I appreciate your thinking of me (or your classmates) Joe, and I do appreciate getting the nice card.

Unwittingly, I left out most of the **George Henning** family Christmas card for a very good reason (above I did not mean witless). Having lost George and Lucy's card in a pile of around 300 cards of the season, I knew that Cal Mohr had one so I asked him to send it to me, which he did. The covers were a large microphotograph of an aluminum-silicon alloy (Matrix?). Now where would that alloy be used George? The first inside fold held the Christmas message from the Henning clan, including the principals, all three beautiful daughters and Lucy's Mom. Further there were a few assorted in-laws supplied by the girls. Just in case some of George's admirers have not heard, George has been a lone male about the home for many years, but he knew that this would all be corrected, as it is the long-time custom of girls to marry males. So now George is one of three. Great! Another turn of the card and the family photos show up: George and Lucy at the opera, home family scenes in the native habitat, and even some scenes from Peru where George and Lucy went on a business trip. One photo showed George and (I hope) Lucy with a few llamas in the background. Now friends, Lucy would look well with any background whatever, but George carried that business too far, as most men would look well alongside of a llama, and this without doubt. George and Lucy, my apologies for not describing your unusual and fine Christmas card before. It was unpremeditated. And again, thanks for thinking of us.

Mal Mayer, the restless itinerant, sends us a card from Nairobi, with splendid thoughts of us. The card showed three icon painters on Cyprus. These painters are, or so it seems, all Fathers of the Greek Catholic Church and its St. Barnabus Mission. So naturally they all sport the long beards, in this case all white. Mal says that soon we will all look like this. Dang it all, this guy comes up with more photos of places that I have never seen than all the rest of the Class combined. I will expect your report, Mal, long before you read this immortal essay. Many thanks and best to you and your lovely.

Now comes one of the items that make life really worth living: a note from one of our lovelies, Doris (Mrs. **Gene**) **Cary,** of Aurora, Colo., who wanted to know, among other things, if M.I.T. publishes a list of living graduates. Yes, Doris, they

do, and have many times, but it is more than that. The *Alumni Register* lists living alumni principally, which includes all those who ever attended the Institute, no matter what happened to them, degree or no. This list is generally the one that carries the office address, whereas ours, that of Ye Secretary, is a list of home addresses. Also listed are the deceased alumni, the faculty and staff, and still further, alumni are listed geographically, so that if one wishes to look up a classmate who lives in Colorado, he just turns to this last list and finds Colorado by cities. Doris goes on to say that she and Gene enjoy the *Review* very much indeed, including the class notes. Thank you Doris, for them kind words, and also thanks more than that for being so nice as to write us, and best to Gene by all means. Fellows and Gals, as you have read previously, Gene is just about 100 per cent crippled, and sure would enjoy hearing from any and all of his old friends, especially those who were his pals in Course XV (Management).

In reply to one of my cards, we have word from **Warren S. Daniels,** formerly of Champaign, Ill., but now of Washington, D.C. and living in Annandale, Va. Warren is still with the U.S. Geodedic Survey, Water Resources Division, and has been in the Washington office for about seven years.

He says that Water Resources, as a unit, is still a source of headaches and challenges, and he still loves it. Men, that is called dedication up our way. I took time to look up Warren's story in *Goodridge 25,* and found that he probably is through with his P. T. A., Cub and Boy Scout work, as the three boys are about all grown up. The eldest boy is working in France as an industrial engineer, with a part of I.G.E.; the second son is out of the army and working in Washington, but Warren does not say anything about his college. He was in Vietnam for one of his army years. The youngest son is still in college at V. P. I. and is a junior industrial engineer. Warren seems proud to announce that he attended his 40th reunion at Somerville (Mass.) High School last November and at that event met **Bob Forbes** and his wife but apparently no other classmates or M.I.T. men. I am a bit surprised as Somerville is one of those high schools that seems to hold a lifetime clutch on its alumni. Few high schools do. Warren and Dorothy now find a top notch excuse for visiting Europe what with one son located in France, so next June they are taking the trip. Now Dorothy, I must rely on you for several postcards as I am more than familiar with the northwest half of France, and somewhat with the remainder, and a card from most anyplace will be one familiar sight or another. Please make my drab life a little brighter with a bunch of cards. I just love to write of travels here and there. By golly, Warren, you sure filled up that return card with plenty of news and we are eternally grateful to you for being so thoughtful. Please do stop in at the old Homestead in New Hampshire and you can phone from the Hampton Interchange first (772-2333).

Now an interesting missive from **Richard** (Dick) **Molloy.** Dick makes no mention of any severing of his connection with United Aircraft, but it is evident that the connection is no more, as his card says that he is still (?) a director of the Longyear Foundation, and it keeps him busy. He and Ruth took a long-planned trip to England last September touring England and Scotland by car. They fell in love with the Cornwall coast, and found the village where Grandfather Molloy was born. Gosh, Dick, we were remiss in not making Cornwall, but did see Devon where Exeter was born, so there. Dick and Ruth have two children; as for grandchildren just one, and "of course, she is a cutie." Heck, they all are, Dick, and welcome to the 1933 Grandfathers Club (not charter). Please keep in mind that grandfathers get no credit here for the performance of their children. Haw! The Molloys are "looking forward to spring," and also to the cottage on Muscongus Bay, on the coast of Maine. No wonder the guy likes boating. That is where our kind of boating was born; fishing and lobstering, too. As a finale, "Best regards to all in old Course XVI (aeronautical)." Dick, and of course, Ruth, I thank you most gratefully for such a fine card and for your thoughtfulness. I do hope that the old Aeros and Astros will write me for your address. As an aside, we have these addresses so that they may be had for the asking, with a short biographical sketch attached as payment.

We have a few briefly inscribed cards from chaps who are still too busy to write; one indeed, says nothing at all, so we will not expose the sender. These short ones are welcome no end even if they are short. After all, it takes some effort to fill in a stamped, addressed card, no? We are sorry to hear, through **L. Hart Cirker,** that the home life of the good Cirkers is disrupted, as Frances is seriously ill. And there is nothing new on the boys, who now must be about 24, 21, and 18. Hart, we are indeed sorry to hear that Frances is not well, and you may be sure that we all are hoping for an early improvement in her health. And please tell her we said so. Thanks for your reply, Hart, in your time of distress. It takes a little more to do that, for sure. Our very best to you both, and do keep us informed about Frances.

Another quick one is from our old friend, **Carl G. W. Swanson,** of Jackson Heights, Long Island, N.Y. I gather that Carl and Katherine have sold their home and are now house hunting. Or maybe they have not sold: they still use the Jackson Heights address. Carl Says that they have been living in Garden City in the house of a friend, vacant as the friends are away on vacation. Carl, we all hope that you folks will find the home that suits you at your price. Did you ever consider an apartment? Wire me the children's ages, and I will advise by the return mail. That's it, and be not afraid; we are glad to hear anything however short. We thank you more than you will know.

Cal Mohr comes through at the appropriate time with some news, scarce as such is. Cal reports that the Chicago supper meeting scheduled for February 17, at which the principal speaker was Dean Pounds of the Sloan School, was to be held at the Mid-America Club on the 39th floor of the Prudential Building, and that the price of the meal was just as high. He observes that the price alone should bring out many of the characters who shun the regular, and mundane meetings at other times. He will inform us, and the 40th reunion committee about what classmates showed up for this meeting, as obviously they have to be potential large givers.

Cal, with reference to your mention of my trip to Mexico City, you are probably not aware of the fact that I will, indeed, become an "Eager Beaver," as I am due for that award to be presented, I hope, at the Noche Mexicana, Saturday, March 14. This award is made to those alumni who attend the Mexico City M.I.T. Club Annual Fiesta four times, not necessarily consecutive: how's that. Many thanks, Cal, for your kind letters and continued support. I do wish I had more like ya! Cal Mohr and Beau Whitton are the only Vice Presidents who do their duty by the Secretary, and it is just that, for all of em—a duty.

Now I get a fine letter from Beau dated in February, in which he makes a short report. He had just returned from New York City and Philadelphia. While in New York, he phoned and found that George and Lucy Henning were in Hawaii, on their first real vacation in years. Just in passing, how many of you fellows and gals know how hard that fella worked for many years after leaving M.I.T. The family business, like most all business at that time, was in a bad way and it took a lot of real application, and more time to pull it out, which George and the other Hennings did. The man really rates a vacation. Gee, I must find out if Lucy ever writes the fellows such as I. Beau also phoned **Dayton Clewell,** a Doctor of Science, Senior Vice President of Mobil-oil, and Executive Vice President of the M.I.T. Class of 1933. Beau mentioned the Clewells' visit to Japan, with the ship christening which was mentioned here earlier. And just before Christmas Dayton and Jean went to Bermuda, but no news as to how long a visit that was. Surely it could not have been business. Haw!

In the City of Brotherly Love, Beau tried to phone **Walt Duncan,** and failed; no reply. It was the same with me in November, and on a Sunday yet. He did reach **James E.** (Jim) **Norcross,** who talked a mouthful about his work travels; three trips to Charlotte and no phone call to Beau; too busy. He made a trip to Dallas, St. Louis, and Chicago, all in one day, and loves it. Heck, so do the airlines. Apparently, Jim had about enough time in each place to mark his "X", and take off.

Gee, I never could sell that fast. In the last issue we gave Jim a real sendoff, in regards to his award for his work with the "working blind."

Beau has been busy. He went to Nairobi to see Mary, his daughter who will graduate from Duke in June. Another daughter is married and living in Charlotte, and his son is still working for his doctorate at Pennsylvania University.

Our very best to this nice fella who does write to the supplicating Secretary of his Class, a service which is quite unique. And of course, best to lil ole Daphne. Say, Daph, I would like no end to hear from you once in a while, just to save wear and tear on the old man. Thanks a million, Beau. You are a joy, no fooling. What ever happened to that survey of the old Course XVII (building construction) classmates? Heck, you'd only have to stir up a dozen, and were I to do that, I'd have better than a hundred old Course II (mechanical) fellas to find and quiz.

To round out the notes for this month we have a card from **T. K. Fitzpatrick,** now of Savannah, Ga., who writes, "Two months have been hectic, moving from Charlottesville to Georgia. Heat pumps, plumbing, wiring, and with many others just cutting holes in the floors." My. My! "I should have hired an architect," says this old guy from Boylston Street. He is, besides that, working on a hospital project and some other architectural work. His plans also suggest that he needs more than one office: one in Savannah, and one in Highlands, N.C. (summer), which he says would make this the best of all worlds. Well, mebbe, say I. In all seriousness, Tommy is in the throes of a change-over and says he misses "the teaching and contact with the young people, so I will have to find some volunteer work in substitution."

Tommy, if one wishes to find out where alumni groups are, anywhere, write Pete Grant, M.I.T. Cambridge, Mass. You are one of my most faithful correspondents, though possibly not the one who writes the oftenest. Thanks the usual proverbial million, and best of luck back in the old home town.

We have two address changes this time: the official one from Tom Fitzpatrick and the other from one Alton J. Deutser, Course XV. These addresses are always available to any and all; just ask by mail with a short biography attached. In passing, I would like to mention that of all those who are mentioned here this month, two wrote me unrehearsed. The remainder made replies to something from me. So we get it, even if we have to dig. Once again, I maintain that every reader ought to write the Secretary once a year. This winds up the June offering; it ought to be summer here in Florida, and will be when y'all read this immortal insert. Best to all of you, and sure, you may write any time. Most sincerely.—**Warren J. Henderson,** Secretary, Fort Rock Farm, Drawer H, Exeter, N.H. 03833

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We have word of the appointment, in January, of **Milton Drexler** to the newly created position of director of research and production of the Chemical Industry Group of the Imoco-Gateway Corp. His new responsibilities cover three Baltimore-based divisions manufacturing a line of chemical specialty products.

After leaving M.I.T., Milton went on to earn an S.M. in organic chemistry from Polytechnic Institute of Brooklyn. He was a senior development chemist at Davis & Geck, Inc. and more recently, vice president and technical director in charge of research and development with Airwick Industries, Inc.

Honors and awards continue to accrue to members of the Class. **Douglas C. MacMillan,** of George G. Sharp, Inc. has received the David W. Taylor Medal from the Society of Naval Architects and Engineers "for notable achievements in naval architecture."

Walter Wrigley, active over the years in class affairs, has been named chairman of the U.S. Air Force Academy Advisory Council. The committee advises the superintendent of the academy at Colorado Springs and comprises twelve members, four of them educators. Walt has been chairman of the academy's curriculum committee. As council chairman, he succeeds Prof. Hardy Dillard who was appointed to the International Court of Justice at The Hague. So you can see he's in good company.

In the April issue we reported on some of **Jerry Raphael**'s activities in and around Berkeley. Now comes a notice of his participation in a March conference on rapid construction of concrete dams. The meeting was concerned with improving the competitive position of concrete versus earth and rockfill dams. Jerry outlined an optimum gravity dam, similar in cross section to an earth dam, but with steeper sides and thus, less volume.

Thanks to Warren Henderson, '33, we have word that **Proctor Wetherill** and his wife Sarah were able to get to the Mexico City M.I.T. Club Fiesta in March. It's nice to get the information, but how come not first hand?

We are sorry to report that, through the Alumni Association, we have word of the death of **Wilbur P. Foote** in August, 1969. The last address we had for him was Everett, Wash. and from the number of chemical engineers listed in that area in the Alumni Register, we presume that his work was connected with the atomic energy field. Can anyone give us some more information about him?

We have just had (late April) the pleasure of a brief visit from Ann and **Ralph Brown.** They had driven down to Cape Cod from Springfield to look for a house for his brother who is retiring shortly. It was good to see them, even if only for a short time. They said they'd had a call from Frances and **John Westfall** who were still getting in some spring skiing.

By the time you read these notes it will be June and lots of you will be going off on summer travels that would make interesting reading. How about a small resolve to write us about them when you get back?—**Robert M. Franklin,** Secretary, Satucket Rd., Brewster, Mass. 02631

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In the March issue of the *Review,* we printed part of a letter from **Jack Colby** of Islamorada, Fla. So, on a recent trip to Florida, I stopped in to see Jack and Priscilla to get the news updated and to see what the Florida Keys are all about. I learned that oldest son, Richard, is due home from Korea in May and will probably head straight for the tarpon fishing; second son, Chris, is still in Africa working for the Peace Corps and expects to be out this fall; and youngest son, Robert, is finishing his freshman year at Hofstra University on Long Island. The balmy breezes and all the flowers in full bloom certainly made it a day to remember. The delightful Colby hospitality included an afternoon of tarpon fishing (sighted but not caught) and a most refreshing swim in the blue Atlantic.

The only other piece of news was a note from **Otto E. Zwanzig** who said he was joining International Resources Ltd., in Denver on April 15.—Co-Secretaries: **Phoenix N. Dangel,** 329 Park St., West Roxbury, Mass. 02132; **Irving S. Banquer,** 20 Gordon Rd., Waban, Mass. 02168

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I regret to report the death in September, 1967 of **Richard B. Collins** and on August 1, 1969 of **Charles E. Trescott.**

The above information, as does a good bit of material for this column, comes from the Alumni Office whose clipping bureau sends on much that is not relevant and often way out of date. This month my own mail bag has contained some newsy bits. The Secretary of '33 sent on the news that **Scott Rethorst** attended the Mexico City Club Fiesta. . . . **Laddie Reday** reports from London that he combined business for American Water Products Corp. with a visit to his artist daughter and a motor trip through England over Easter. . . . **Spencer Mieras** finds time is catching up on him following mention in these notes of our 35th reunion. He has so far been unable to attend a reunion but Warner Gear in Muncie, Ind., of which he is president has purchased a plant in New Bedford and he will plan a business trip so as to insure his presence in June 1971.

As I turned the pages of *Chemical and*

Engineering News a familiar face stared out at me. **Henry McGrath,** Vice President of Canadian Kellogg Co., Ltd., was a speaker at a New York meeting of the Commercial Chemical Development Association. His concern was that the rising costs of new plant construction in the U.S., if continued, would result in U.S. industry being priced out of world markets. . . . **Dorian Shainin,** Vice President of Rath and Strong of Boston conducted a seminar for the Western Massachusetts Section of the A.S.O.C. in Springfield in February. The topic: "Practical, Down-To-Earth 1970 Shop Quality Control." . . . **Paul Robbins** as executive director of the National Society of Professional Engineers has put the society on record as favoring a federally sponsored urban mass transit program and opposing an executive order which it contends may force federal engineers to engage in collective bargaining whether they want to or not.

Your Secretary as president of the Unitarian Universalist Women's Federation has been recorded in favor of repeal of Abortion Laws and passage of the Equal Rights Amendment. As a freshman I can remember some interesting discussions in the drafting room of "woman's place." I am still fighting.—**Alice H. Kimball,** Secretary, P.O. Box 31, West Hartland, Conn. 06091

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Edwin T. Herbig, Jr. is retired and is active as president of the Minnesota Higher Education Coordinating Commission. . . . **Eric Moorehead** is living at 657 Mission St., San Francisco, Calif. 94105. His children are all grown, youngest 24, and oldest 30 and he has two grandchildren, both girls. . . . **Floyd B. Schultz** was recently promoted to vice president of Ingalls East Shipbuilding Division of Litton Industries in Pascagoula, Miss. . . . **Milt Lief** has recently left Alvey, Inc., and now is associated with Nixdorff-Krein Mfg. Co., which is headed by Ellis Littmann, '33 as president. Milt's son, Lawrence is graduating from Princeton in June and is heading for medical school. His daughter Debra is a freshman at Christian College in Columbia, Mo., and his older daughter, Anne is working and living in Boston.

Vladimir Haensel, Vice President and Director of Research at Universal Oil Products, Des Plains, Ill., and an authority on catalysis, has been elected chairman of the American Chemical Society's Division of Petroleum Chemistry. Research conducted by Dr. Haensel in catalytic refining of petroleum caused the development of a vast new technology and literally changed the world in which we live. His many contributions to petroleum and petrochemical technology—some 120 patents and more than 60 technical papers—have been recognized by the Chicago Chamber of Commerce Award in 1944, the Precision Scientific Award for Achievement in Petroleum Chemistry in 1952, the honorary degree of Doctor of Science from Northwestern University in 1957, the American Chemical Society Award in Industrial and Engineering Chemistry in 1964, the Modern Pioneer Medal in Creative Chemistry awarded by the National Association of Manufacturers in 1965, and the 1967 Perkin Medal for outstanding work in applied chemistry awarded by the American Section of the Society of Chemical Industry.

George W. Ewald, who organized and for 12 years managed one of the leading synthetic industrial fabric departments of the textile industry for J. P. Stevens and Co., Inc., has resigned from Stevens and has opened his own textile consulting firm of George W. Ewald, Inc., 76 Woodland Road, Maplewood, N.J. 17040. . . . **Harvey F. Phipard** has retired as director of engineering, Continental Screw Co., but is still active as a selling representative for screw making equipment. Harvey alternates between homes in Florida and So. Dartmouth, Mass.—**Robert H. Thorson,** Secretary, 506 Riverside Ave., Medford, 02155; **Curtiss Powell,** Assistant Secretary, Room 5-325, M.I.T., Cambridge, Mass. 02142; **Jerome Salny,** Assistant Secretary, Egbert Hill, Morristown, N.J.

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Your class Secretary is writing these notes in haste, because tomorrow he is going to leave to go to Majorca on the M.I.T. group safari. Obviously, I am not looking for sympathy. All of which reminds me that Warren Henderson who is Secretary of the Class of 1933 sent me a postcard informing me that **Bob Bowie** and his wife Hattie attended the Mexico City M.I.T. Fiesta. . . . I have a postcard from **Bert Grosselfinger** informing me that while I'm not an actor's agent, I might be interested in knowing that Bert is appearing as Cardinal Castelli in "Five Star Saint."

Dick Muther is the co-author of a new book "Systematic Handling Analysis," published by the Industrial Education Institute of Boston. As you know, Dick is president of Richard Muther and Associates, Inc., who consult in industrial and management engineering. Dick has written about four other books and, I am told, has written somewhat over a hundred articles in management subjects.

A news release indicates that **Henry Mudd,** Chairman and Chief Executive Officer of Cyprus Mines Corporation, has located a real bonanza in lead, zinc and silver in Canada's Yukon territory. Frank Kemp, our smiling Class Agent, should take note of this for next year's M.I.T. Alumni Fund. . . . **Tom Doherty,** who is with the Canadian Products Department of Imperial Oil in Toronto, has been elected president of the Canadian Society for Chemical Engineering.

Bruce Old has been appointed the first foreign secretary of the National Academy of Engineering. Bruce is senior vice president of Arthur D. Little, Inc. . . . **Syd French** has been appointed assistant director of research and development for Phelps Dodge Tube Company in South Brunswick, N.J.

This issue of the *Technology Review* will probably hit you just about at the time of Alumni Day. If by chance it comes in before, and you have not made your reservations for the Pops Concert, use your influence and call up Don Severance for an emergency reservation and I'll see you then—.**A. L. Bruneau, Jr.,** Class Secretary, Hurdman and Cranstoun, Penney & Co., 140 Broadway, New York, N.Y. 10005

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Harlan E. McClure, Dean of the College of Architecture at Clemson University, was guest lecturer in the College of Architecture and Planning at Ball State University, Muncie, Ind., last February. His topic involved South Carolina's 300 years of statehood and the two major pavillions which are being built as the vehicles for this Tricentennial celebration which is open to the public. Harlan has degrees in architecture from George Washington University, from the Royal Swedish Academy in Stockholm in architecture and city planning, as well as his degree from M.I.T. He has taught at the University of Minnesota and at Clemson. He serves as secretary-treasurer of the Clemson Architectural Foundation.

John F. Wilson has been elected a director of the American Institute of Management. John is also vice president-Northeastern United States for Texas Instruments Incorporated. A native of Salem, he was employed as an assembly supervisor by Sylvania Electric Products after graduating from the University of Maine in 1933. His current affiliation dates back to 1957, when he was appointed general manager of marketing for Metals & Controls Inc., since merged with Texas Instruments. He was transferred from Attleboro to Dallas as vice president of Corporate Marketing in 1966, and returned to Attleboro in his present position in October 1968. He is a director of the First National Bank of Attleboro and a member of the Attleboro Chamber of Commerce.

Sam Fry who is in system engineering on space shuttle at Boeing reports that last summer he visited a daughter in the Peace Corps in Tunisia, and another daughter doing graduate work at the University of Tübingen in Germany. He also has a third daughter presently enrolled at Waseda University in Tokyo and a son, twin of the third daughter, at the University of Washington. Sam says that he still enjoys skiing and mountain climbing in his spare time.

Newell H. McCuen has been appointed manager-forward planning product analysis and control which is a new responsibility in the corporation en-

gineering staff of General Motors.

George O. Lloyd has recently announced his resignation from the architectural firm of Higgins, Webster & Lloyd to enter private practice of architecture in Bangor, Maine. . . . **George M. White** is the author of a new legal column which appears in the *Building Design & Construction* magazine, formerly called *Building Construction.* George is an architect, lawyer, and engineer who holds both B.S. and M.S. degrees from M.I.T. He is also a director of the American Institute of Architects.

Joseph G. Gavin has recently been elected a senior vice president of Grumman Aerospace Corp. Joe is director of space programs. . . . **Richard F. Cottrell** has been named president of Aerojet Solid Propulsion Company, Sacramento, Calif. The company was formerly known as Aerojet-General's Solid Rocket Division and has been newly formed by Aerojet as an autonomous company. Dick had been the Aerojet vice president and general manager of the predecessor division. On the formation of the company, Dick said "It gives us the organization we need to compete in today's tight defense and space market. . . . It will give us the flexibility needed to effectively penetrate the solid propulsion market."—**Walter J. Kreske,** Secretary, 53 State St., Boston, Mass. 02109; **Everett R. Ackerson,** Assistant Secretary, 831 Cranford Ave., Westfield, N.J. 07090; **Michael Driscoll,** Assistant Secretary, 23 Broad St., Nantucket, Mass. 02554

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Note from **Bill McGuigan,** who has been consulting in research and engineering since leaving Stanford Research Institute in 1966. Some of his recent activities include: a review of policies and programs for army aviation, types of industry and sources of technology for the development of Angola and new technology for the Henequen industry of Yucatan.

Really don't know what **Maurice Taylor** is doing but have his report that his daughter, Maureen, will graduate from Cornell in June and has been awarded a Woodrow Wilson Fellowship for graduate study leading to a Ph.D. in American civilization. Maurice's wife, Flora, completed her master's degree in psychiatric nursing last year and is now serving as associate professor of nursing at the University of Niagara.

The University of Southern California's Institute of Aerospace Safety and Management has appointed Dr. **Steve Stephanou** professor of aerospace technology. Before coming to U.S.C., Steve was branch chief, applied research in the Advanced Propulsion Department at McDonnell-Douglas Aircraft Corporation. Previously, he was assistant to the chief of Apollo Propulsion Analysis at North American Rockwell Corporation.

Calvin Morser has been named assistant vice president of Itek Corporation's Optical Systems Division in Lexington, Mass. Prior to joining Itek in 1963, Cal was program manager and chief engineer for the Nortronics Division of Northrup Corporation at Needham. . . . **Monroe Sadler,** Director of the Development Department at du Pont has been elected to the board of directors of Block Engineering, Inc., in Cambridge.

Frank Card has been appointed assistant to the president of H. Kohnstamm and Company in New York City. He was executive vice president of the Tenneco Color Division in Easton, Pa., and before that, a product manager at General Aniline and Film Corporation.

Charlie Ricker, who was vice president and director of research with First Michigan Corporation has joined Heber-Fuger-Wendin, Inc., as account executive and portfolio manager. Charlie spent 13 years with the National Bank of Detroit where he established, and was director of, its business and banking analysis department.

Russell W. Brown has been named engineer of the year at General Dynamic's Electric Boat Division. Russ has been with Electric Boat since 1951 and was design engineer and chief engineer on power plant and component design for Nautilus, Seawolf, Triton, Scorpion and Tullibee. . . . On a trip to Mexico during early April, Jean and I with Francine and **Jim Stern** met **Erwin Anisz.** He's still in the paper mill business with CIA Industrial DE Attenquique, S.A., and has hardly changed at all since leaving Cambridge. If any of you are in Mexico City, his address is Socrates 389-4, Mexico, D.F.—**Ken Rosett,** Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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John C. Stetson was elected president of the A.B. Dick Company of Chicago. He was president of The Houston Post, and will continue as a director of The Houston Post Company. . . . **Virgilio Barco Vargas,** former mayor of Bogotà, Colombia, is now in Washington, D.C., as Executive Director of the International Bank for Reconstruction and Development. He has also been elected as a member of the M.I.T. Corporation, which, with **Irenee dePont, Jr.,** gives our Class two members of this governing body.

Charles Coles was the subject of an interesting article in the *Boston Globe* earlier this year. It appears that he commuted to work daily from Manchester Harbor to Hingham all winter (and still does so, we presume) in a 12-foot fiberglass boat of his own design, called the Hydro RFT. It is a 50 minute run, as against 70 minutes by automobile. The hull has a tunnel forward that flattens out to a hydroplane at the transom, and there are two metal foils that supply the lift. He powers it with a 40 horse power outboard, and steers it with a stick instead of a wheel. He has run it at 38 m.p.h. (33 knots?) in normal sea conditions, and doesn't require wet weather gear. Charlie is vice president of Pyrotector Company.

Gray C. Trembly says: "I only took a single course, 6.621, and so hardly anyone knows me and vice versa. Have been in Boston area electronics ever since; currently with Raytheon Bedford Labs. The company is offering a course in solid state physics by Professor Paul Gray which is very good." Not bad for a one-course man! You are now duly "introduced" to your '43 classmates, Gray, so no more apologies! Be expecting to hear from the Alumni Fund, too!

Raymond Frankel, president of Technological Investors Management Corp. (TIM), was the subject of an interesting article in *Footwear News,* where the reporter expressed surprise at Ray's conservative appearance, quiet mannerisms, and technological expertise. It seems that people imagine fund operators as fast-talking swingers, which Ray is not, as we all know. TIM has engineers and other trained people who can evaluate a company. . . . Dr. **Mary V. McDermott,** who received her MPH with our Class, led a symposium in Youngstown, Ohio, recently on perceptually handicapped children. She is a pediatric neurologist in Detroit.

Robert Kelso, Vice President-Technical of the Cornell Aeronautical Laboratory, was the subject of an article in their Lab magazine recently, which discloses things he never dared tell us. It appears Bob has been very shy about his many talents and experiences, which make fascinating reading. Also at Cornell is **Malcolm S. Burton,** who received his masters in metallurgy with our Class. He is a professor of materials science and engineering and is also associate dean of the College of Engineering.

Carlton G. Lehr, who is with the Smithsonian Institution Astrophysical Observatory in Cambridge, Mass., is the author of an I.E.E.E. article, "Geodetic and Geophysical Applications of Laser Satellite Ranging", which is his specialty. He also is a lecturer in mathematics at Northeastern. . . . Professor **Bill Laird** telephoned Secretary Feingold on Mother's Day (as he always does?) to report he was at Bradley Airport on his way back to Fredonia, N.Y. after a parents day visit at Northampton School for Girls. He said that he and Sally spent considerable time with **Jim Spitz** and his wife there. Bill also has a daughter at college in Pasadena, Calif., and Jim's son is a DKE at Vanderbilt.

Classmates still meet frequently at the M.I.T. Faculty Club, usually for Alumni Advisory Council affairs. At one time or another most of the Boston area fellows show up, and it is always a lot of fun. Council gatherings are usually held on the last Monday of the month between October and May. These dormant

years between reunions are no excuse for lack of communication, so call or write, and remember, you are always welcome by any classmate any where you may be. Have a happy summer!—**Richard M. Feingold,** Secretary, 266 Pearl St., Hartford, Conn. 06103; **A. J. Kelly, Jr.,** Associate Secretary, 34 Scudder Rd., Westfield, N.J. 07090

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By the time you are reading these notes you are probably making your plans for summer vacation. Should you come through Washington, may I suggest you give me a call to bring us up to date on your activities. (Office phone is 932-8020 and home is 938-0434). This month we start with a notice concerning cooperation rather than professional advancement, as is usually the case. **Martin Annis,** E.E., President of American Science & Engineering Co., in Cambridge, received good publicity from the *Boston Globe* in mid-March by his "hand-shake" agreement with Tom Farrington of Input Output Computer Services, Inc. Since A.S. & E. is expanding rapidly into the process control business, it was natural to cooperate: A.S. & E. supplies the system (based upon the PDP-8 computer), and I.O.C. furnishes the software which will drive the system. Farrington is a black entrepreneur whom Martin cites as a "darn good salesman."

Andrew F. Corry, S.M., E.E., is back in the news for us again (see February notes). He has another article, "Underground Transmission in the U.S.," in the *IEEE Spectrum* for March 1970. The notice was sent to me by Carole Clarke, Secretary of the Class of 1921, and was appreciated since I have been considering a study in this same area.

Another class Secretary, Warren Henderson, Class of 1933, sent me a card stating that Senor **Arturo Morales-Dominquez** attended the 1970 M.I.T. Mexico City Club Fiesta. The Washington D.C. Club (under **Al Picardi,** see below) has found that similar informal meetings, e.g. picnics and beer parties, have been quite successful.

From the *Connecticut Industry Monthly,* we find that **Norman L. Greenman,** C.H., B.S., M.S. was elected to the board of directors of the Manufacturers Association of Connecticut. Norm is president, director and chief executive officer of Rogers Corp. in Rogers, Conn. After serving in the army engineers, he joined Rogers as a development engineer and advanced through planning and marketing to executive vice president in 1964. He was made president in 1966 and is also a member of several other boards and professional societies.

The appointment of **Warren H. Howard,** M.E., to vice president-marketing has been announced by the Morgan Construction Co., manufacturers of wire drawing machinery, rolling mills, bearings and combustion controls. Previously he was vice president and manager of the MORGOIL Bearing Department and Pittsburgh district manager. Before joining Morgan, Warren was with G.E. for 11 years. He is a past president of the Rolling Mill Machinery and Equipment Association and the Engineers Society of Western Pennsylvania. He resides with his wife, Louise, and sons, Roger and Kenneth at 10 Mass. Ave., Worcester. His son Peter is a graduate of Princeton, daughter Cynthia is a senior at Connecticut College for Women, and son Steven is a senior at Pomfret School.

Malcolm G. Kispert, A.A., S.B., S.M., has been elected to the board of directors of Baird-Atomic, Inc., of Bedford, Mass. As you know, Mal has been vice president-academic administration at M.I.T. since 1961. He is also a trustee of the Hampton Institute and Dana Hall School, a director of the Cambridge Trust Co., and a vice president and director of the Harvard Coop.

Mrs. Katharine A. Kulmala, A.R., M.C.P., was written up in *Union,* the newspaper of Springfield, Mass., January 27, 1970. Katharine is a professional city planner and also the Democratic nominee for a five-year term on the Planning Board of West Springfield. She has worked with The Planning Services Group, Inc., of Cambridge since 1956. Most of the work has been with small-to-medium size towns, including a revision to the Town of Auburn's zoning by-laws and a handbook on cluster zoning. She is a member of the American Institute of Planners and of the Association of M.I.T. Alumnae.

As I promised above, I have a news item about **Alfred Picardi,** C.E., who is the president of the D.C. Club. He represented the Institute at the inauguration of James Cheek as 15th president of Howard University. Al and **Paul Robinson,** A.A., did a fine job here last week as the Club sponsored a visit by the M.I.T. Symphony Orchestra followed by a coffee at the Arts Club.

The *Blade,* of Toledo, Ohio, reports on February 6 that **Dean C. Picton,** P.H., has been named executive vice president of Picton-Cavanaugh, Inc., a fire and casualty insurance agency. Dean joined the company in 1947 and has done well —his picture showed him to be as handsome as ever.—**John G. Barmby,** Secretary, IITRI, 1825 K St. NW, Washington, D.C.

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Vince Butler represented the Institute at the inauguration of Albert R. Jonsen as the 23rd president of the University of San Francisco in late February. . . . The October 1969 issue of *IEEE Transactions on Power Apparatus and Systems* contained an excellent article by **Nelson E. Chang** captioned "Locating Shunt Capacitors on Primary Feeder for Voltage Control and Loss Reduction." This article is just one of several that Nelson presented. Nelson continues as an engineer in the Distribution Engineering Department of the Long Island Lighting Co. . . . **W. Wai Chao** a recent post doctorate Fellow at the Center for Advanced Engineering Studies, has been appointed director of administration and market planning at the Sperry Rand Research Center in Sudbury. Dr. Chao has been with Sperry since 1959 with prior experience at Ford Motor, Curtis-Wright and Bell Aircraft.

William K. Linvill, Executive Chairman of Stanford University's Department of Engineering—Economic Systems continues to be active in his field. After scanning two papers Bill presented this past winter I continue amazed with the work that Bill, **Jay Forrester** and others do in this field of system analysis and decision making. . . . Your Secretary fully enjoyed a lengthy plane conversation with King Cayce, '44, in early March. Pat and King together with their two children divide their time between N.Y.C. and Florida. King continues his financial activities and interests through his Interstate Financing operation.—**Clinton H. Springer,** Secretary, Fireman's Mutual Ins. Co., 420 Lexington Ave., New York, N.Y. 10017

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We are sorry that there were no class notes in the May, 1970 issue. Unfortunately we had absolutely no material for that month. I believe this points out how important it is that some of you please write and inform us of your activities. We have been more fortunate this month, and while I would not say the mail rolled in, it was better than in past months.

William Jackson, Jr., sent us a fine card on his activities from his home in Woodside, Calif. After graduation from M.I.T., Bill served on active duty with the navy at the Boston Naval Shipyard. During the Korean War, Bill served a second tour of duty in the navy and is now a captain in the naval reserve. At the conclusion of the Korean War, Bill was with the Turbine Division of the General Electric Company in Schenectady, N.Y. For the past 10 years he has been with the Lockheed Missiles and Space Co. in Sunnyvale, Calif., working on the Polaris program. Bill and his wife, "Franky," were married in 1951 and have one daughter, Betty Ann, aged 13.

Bill Rapoport attended the Wharton Graduate School after graduation from M.I.T., obtaining an M.B.A. in marketing. Bill joined American Cyanamid Co. in 1949 and worked in sales, market development, as regional manager and as product manager through 1966. I saw Bill and his lovely wife twice in that time when he visited relatives where I used to live in Birmingham, Mich. Bill is now sales manager for paper chemicals at Sun Chemical Co. in New Jersey, and lives with his wife, son and four daughters at Mountain Lakes, N.J. Bill has had the opportunity to travel extensively in the U.S. and has kept up his great interest in bridge. I remember him as one of

the avid and excellent bridge players when we attended M.I.T.

I received a very fine letter from our classmate and good friend, **Ed Belcher.** Ed has written a very fine and complete resume of his activities these past years.

Upon graduation in 1946, Ed worked at Ansco in Binghamton, N.Y., as a staff engineer on projects pertaining to the manufacture of cameras. In 1948 Ed left Ansco and joined Chase Brass in Waterbury, Conn., in manufacturing engineering, working on drawn metal parts and machine design. In 1953 Ed joined Graflex in Rochester, N.Y., working in manufacturing engineering. Ed joined his present company, Caldwell Manufacturing Co. of Rochester, N.Y., in 1956 as production manager. Caldwell Manufacturing Co. produces balancing apparatus, weatherstripping and hardware for hung wood and aluminum windows. The company has approximately 150 employees with additional plants in Philadelphia and Jackson, Miss. Ed has been executive vice president since 1967 and says his work is fun even with the normal frustrations. I am glad to hear him say that, for work should be fun and those that find it that way are fortunate. I still find my work to be fun and so I can understand what Ed means. Edward and his wife, Jacqueline, were married in 1953, and their family has grown to three girls, aged 8, 9 and 13, and a boy 7. The Belchers live in a 50-year-old house in the city, having moved in from the suburbs seven years previously. They are strongly committed to the city and toward the eventual solution of the many problems confronting the city. The Belchers were deeply involved in last winter's fight to integrate the public schools, and they continue to be active in the groups continuing this effort. Ed has also been active in studying school financing; on the county board of health; chairman of the Art Gallery Finance Committee; and chairman of the Advisory Board of Inner-City Community Education Centers. When there is time from these busy and outstanding endeavors, Ed spends it skiing, sailing, working in the yard or vacationing on Nantucket in August.

Robert A. Summers since June, 1969, has been manager, advanced programs and technology, Earth Observations Program, Office of Space Science and Applications of N.A.S.A. in Washington, D.C. The Summers family includes Bob, his wife, Sherma, and twin girls nearly three years of age. . . . **Gifford H. Stanton** has been elected a manager of Drake Sheahan/Stewart Dougall Inc., of New York City. Gifford joined the firm, which specializes in marketing consulting, in 1954. . . . **Edmund Sellman** has joined the Federal Aviation Administration in Washington since leaving the navy in January, 1970.

Shaffer E. Horne, who received his degree in chemistry at M.I.T., has been engaged in low density polyethylene film applications research at the Texas City, Texas Research Laboratories of the Monsanto Co. during the past 10 years. Shaffer has recently collaborated on an article on plastic film for the November, 1969 issue of the *S.P.E. Journal,* the magazine of the Society of Plastic Engineers, Inc. . . . **Mrs. Roberta K. French** attended the M.I.T. Mexico City Club Fiesta that was held a few weeks ago. Mrs. French is now a resident of Guadalajara, Mexico. . . . If you wish to keep reading these notes, then please begin writing some notes to—**Russ Dostal,** Secretary, 18837 Palm Circle, Cleveland, Ohio 44126

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A shortage of news this month will allow me to get to the golf course without any undue delay, and believe me, these days I need as much practice as I can possibly get. Ruth King, Associate Editor Emerita of *Technology Review,* reports that **E. Russell Johnston** has left the University of Connecticut at Storrs and is now visiting professor at the Federal Institute of Technology in Zurich. His wife and two sons are with him and hopefully all had a good winter on the slopes. . . . Carole Clarke, Secretary of the Class of 1921, writes that Dr. **Pete Poulos** gave a beautifully illustrated comprehensive presentation, "Modern Concepts of Modern Surgery" to the M.I.T. clubs of Northern New Jersey. It is interesting to note that Pete graduated with us in aeronautical engineering and is now associate professor of surgery, New Jersey College of Medicine, and chief of cardiac surgery, United Hospitals of Newark.

Neil Blair has been appointed director of special projects of John Diebold, Inc., the management and investment firm. Neil was formerly vice president-business planning and development with Bunker-Ramo Corporation. . . . A Boston news clipping advises that **George Katz,** President of Niagara of Boston has been appointed chairman of the annual dinner meeting of the Greater Boston Chapter of the American Jewish Committee. George has been most active in the Boston Jewish Organizations and in 1967 received the Young Leadership Award of the combined Jewish Philanthropies. George, for all that fine work I should get to Boston and take you to lunch some Friday at the Oyster House. . . . As you can see I've run out of news so until next month.—**Dick O'Donnell,** Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

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Final reminder that the Class of 1949 is holding its cocktail party on Sunday afternoon, June 14, at 3:00 p.m. in McCormick Hall. See you there!

We have three items of interest from Alumni Fund envelopes as follows: **Murray Glauberman** reports that his son, Stuart, has been elected president of the freshman class at Indiana Institute of Technology in Fort Wayne. Somehow that note suddenly makes me feel much older. . . . **Robert F. Steinhart** reports: "My wife Roselyn and I live in Springfield, N.J. Our children are Judith (16), Jonathan (14), David (12), and Frederic (10). I am about to complete my fourteenth year with I.B.M. and am currently manager of education and communication at I.B.M.'s Management Information Systems Center in Mahwah, N.J." . . . Finally, **Raymond L. Dujack** reports that after many years of engineering in the aerospace business, he joined Western Union in the corporate development operation as part of the executive office. Their work is focussed on mergers and acquisitions, etc. On the personal side he reports: "a marriage in 1959, two children (Stephen, 17 and Susan, 15) and, unfortunately, a divorce in 1965."

A few days ago I received news from the Alumni Office that **Francis D. Harrington, Jr.,** died on March 4, 1970. So far, I have no additional information. I hope to have more to report next month.—**Frank T. Hulswit,** 77 Temple Rd., Concord, Mass. 01742

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Jim Kennedy of 6 Old Orchard Rd., Westport, Conn., has an article in the current (April) issue of *Yankee* magazine published here. Titled "An Auctioneer Is Like a Tomato," the story is a profile of one of New England's most active auctioneers, Ed Stevens of West Rindge, N.H., and is full of quotes and anecdotes about the business. The story came about as a result of Jim's addiction to auctions and tag sales, he says, plus an affinity for writing developed in his daily business. He is president of PR-New York, Inc., a Manhattan agency for out-of-town public relations practitioners, and he also operates James H. Kennedy & Co. with headquarters in Westport. Also, by more than chance, the Kennedys (they have seven children) have a second home in Fitzwilliam, N.H., just a few miles from Ed Stevens' auction barn. There is frequently at least one Kennedy at each auction Ed holds, especially during the summer.

J. F. Hutchinson was appointed director of product quality and safety for the Goodyear Tire and Rubber Company in August 1969. . . . **William H. Enders** joined Magnavox in February of 1970 as director, business development operations, reporting to the president. He is responsible for directing growth of company through internal product development and acquisition. . . . **F. L. Wideman, Jr.,** of Locust, N.J., has been named general manager of the Madison Laboratories of Ciba Corporation. The laboratory produces proprietary drugs. He is a former vice president of Johnson & Johnson.

Attending the recent 1970 M.I.T. Mexico City Club Fiesta were your classmates **Richard S. Bolin** (a club officer) with

his wife, Jeanne, and **Martin Cornish** and his wife, Ingebord. Martin, as is well known, is the son of Nish Cornish, Class of 1924. . . . **Robert L. Titus** has been named general products manager of Arrow-Hart, Inc. This is a newly created job and he will be responsible for the development of all new products, the modification of existing products and for developing new applications of products to meet short and long range marketing requirements. Mr. Titus will be responsible for the activities of the product manager in each division of the company's two domestic groups. He is a native of Little Rock, Ark.

Gordon D. Sargent has been promoted to the position of chief project engineer for Nopco Chemical Division of Diamond Shamrock Chemical Company. In his new position Sargent will manage the central engineering project department, which is responsible for the design and construction of new plants and additions and major alteration to existing facilities. He joined Nopco in 1967 as a project engineer in the central engineering project department. His previous experience includes positions as senior project engineer with Celanese Fibers Company, a project engineer for Hooker Chemical Company, a research officer in the Army Ordnance Corps at Picatinny Arsenal, and a foreign production engineer for Colgate-Palmolive Company. His most recently published articles, which appeared in 1969, dealt with air pollution control. They included "Dust Collection Equipment," which appeared in the January issue of *Chemical Engineering*, and "Gas Scrubber Cost Data," which appeared in the December issue of the *Journal of the American Association of Cost Engineering.* He lives in Morristown, N.J., with his wife and two children.

In 1962 **Samuel O. Raymond** founded an oceanographic company on Cape Cod named "Benthos." Benthos designs and produces a variety of oceanographic equipment—underwater acoustic devices, biological and geological sampling equipment, hydrostatic pressure testing systems and services and general deep-sea hardware and instrumentation. It is located in a brand new $300,000 building and employs close to 30 people. Gross sales in 1969 were around $600,000 and the company had its first public offering of stock last spring. . . . **H. M. Voss** of the Boeing Company is serving as technical program chairman at the AIAA/ASME 11th Structures, Structural Dynamics, and Materials Conference, being held in Denver, Colo., on April 22-24, 1970—**John T. McKenna, Jr.,** 2 Francis Kelly Rd., Bedford, Mass. 01730

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Marshall Blank was promoted to assistant chief, regional planning branch, Corp of Engineering in the San Francisco district. His responsibilies include examination of navigation, flood plain management, control of beach erosion, waste disposal and general environmental and ecological aspects of San Francisco Bay. . . . **Robert Cushman** presented a seminar at the M.I.T. Nuclear Engineering Department on engineering breeder reactors (EBR II). Bob is at the Idaho Division of Argonne National Laboratories. . . . **Jerome Elkind** ran for school committee in Wayland, Mass. and rumor has it that he made it.

Alfred O. Ginkel has just returned from Hong Kong where he was the general manager of Sybron Corporation's Hong Kong subsidiary: Sybron Asia LTD. Al and Jean have three daughters. . . . **Eugene E. Koch** is division president of Wards Co., Inc., appliance and TV retailers with coast to coast operations. Although his responsibilities cover stores from Albuquerque, N.M. to Milwaukee, Wisc., he and Betty live in Virginia Beach, Va. They have four sons ages 9 to 15.

The 1970 M.I.T. Mexico City Fiesta was attended by three of our classmates and their respective wives (as reported to me by Warren Henderson, Secretary, Class of '33): Francis and **Breene Kerr,** Phyllis and **Oscar Ancira** and Mattie and **William Gable.**

Dan Magnus is manager of advanced ground transport systems at General Applied Science Labs in Westbury, Long Island. He was the program chairman of the 1970 JTEC Conference of the American Institute of Astronautics and Aeronautics which covered topics in the field of transportation. . . . **William Maini** is a director of the Cambridge Chamber of Commerce and was on a committee recently which planned new quarters and a new location for the Chamber. Bill is president of Symmes, Maini & McKee, Inc. . . . **Charles Miller** has been receiving quite a bit of publicity now as the new head of the Charles Stark Draper Laboratories (the former Instrumentation Laboratory) at M.I.T., and simultaneously as the director of the Urban Systems Laboratory and, as the associate dean of the M.I.T. School of Engineering. Charlie was featured in the center page spread of the February 1970 issue of *Computer Decisions* under the heading: "Decision Makers." The extent of his current responsibility was summed up in the interview where, in his own words he said: nine years ago he was "a lonely little assistant professor of surveying, almost." Today he estimates that the computer equipment alone that he uses is about a quarter of a million dollars a month in rental value.

Robert G. Norton is general manager of the engineering division of Cabot Corporation. The Nortons live in Pampa, Texas and have four children ages 9 through 15. . . . **John O'Brien** is living in Guadalajara, Mexico for a few years to help start a new film manufacturing plant. John emphasizes that this is a popular tourist spot and would be happy to see any alumni passing through the area. . . . **Dick Reedy** is president of Cordell Engineering, Inc., in Everett, Mass. His company received the 5th annual Bachner award for outstanding use of plastics in their Varifilm 321 Rapid Film Processor. Dick and Carol are living in Melrose. . . . Kit and **Dave Ragone** have acquired a yellow Labrador retriever to take up their remaining free time in Pittsburgh. David is no longer in the metallurgy department at Carnegie-Mellon University. He is now the associate dean of the School of Urban and Public Affairs. The areas of concern of this job include air pollution, housing, education, etc. This is a graduate school program, and they are inviting applicants for the first class which meets in September, 1970. Along with this, David is serving as one of the advisors in an inter-disciplinary project at Carnegie-Mellon with the departments of Chemical Engineering and Metallurgy and Materials Science whereby about a dozen seniors are investigating problems with air pollution in Western Pennsylvania's Allegheny County. Dave is keeping up with his squash and was runner-up in class B last year. He reckons that he has become very fortunate now that he is over 40 because he doesn't have to play against the 17-year-olds anymore. Kit is still swimming three or four times a week and when all else fails, she spends her time chasing children (or a yellow Labrador retriever).

It is nice to have friends who write letters. . . . Another one who writes a nice note is **John P. Dowds** of Oklahoma City. John is an active consulting geologist, president of Adamana LTD (oil and gas exploration), he is regional chairman for both the M.I.T. alumni fund and the M.I.T. Educational Council, president of the Mens' Club of the Congregational Church and a prolific publisher of technical articles. His technical papers deal with mathematical approaches to petroleum exploration and, from *World Oil* December, 1968, we have an article which cites his achieving a success rate of 50 per cent or better in the drilling (wildcat and otherwise) of 118 wells. John, you've made yourself a good candidate for the alumni fund!

Paul Hayashi has been appointed to the engineering staff of Scott Co., mechanical contractors, in their Oakland, California headquarters. After his bachelor's degree at Tech, Paul went on to Cal Tech for a master's degree. . . . Dr. **Yngve Hendrickson** was named senior research associate in lubricating oil additives at Chevron Research Co., Richmond, Calif. My records show that Yngve and Nancy have two young daughters. . . . From Decatur, Ga., our final note, **Jerry Champlin** presented a paper on nuclear excavation titled "An Interior Seaway for Northern Africa." Jerry is with Georgia Tech, but the symposium was held in Las Vegas (that's taking quite a chance). The news was brought to you by—**Howard L. Levingston,** Secretary, 358 Emerson Rd., Lexington, Mass. 02173; **Marshall Alper,** Assistant Secretary, 1130 Coronet Ave., Pasadena, Calif. 91107; **Walter Davis,** Assistant Secretary, 346 Forest Ave.,

To Remember and Honor

Were it not for the pride an M.I.T. '21 man took in the excellence of his craftsmanship; were it not for the pride his company took in his value of creativity and progress; were it not for the pride of his grandson in the recognition and honor his company gave him posthumously, and were it not for the pride of his fellow alumni, this story might never have been told.

Credit must go to Joseph D. Lurie, a 15-year-old Lexington, Mass., high school freshman, for triggering the events which led to the story being recorded. Early this year, Joe wrote to the editor of *Technology Review,* saying: "Last summer a ground-breaking ceremony took place in Rogers, Conn. The Rogers Corp. had started construction of a new building to honor my deceased grandfather, Joseph M. Lurie, Class of 1921.

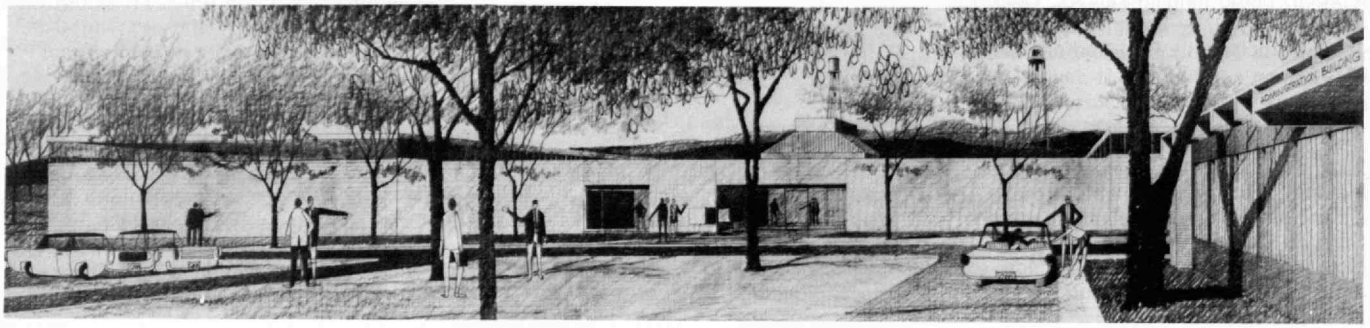
"The Lurie Research and Development Center will be completed in the summer of 1970. It would mean a lot to my family if you would mention this in the '21 Class Review section of *Technology Review.*"

The *Review* forwarded the letter to Carole A. Clarke, secretary of the Class of 1921, a classmate and longtime friend of Saul M. Silverstein '21, chairman of the board of Rogers Corp., and Raymond A. St. Laurent '21, Rogers' retired vice president—sales, and also president of the Class of 1921. Both Saul and Ray were intimate friends of the late Joseph M. Lurie '21 and were graduated with him in Course X at M.I.T.

Subsequent correspondence with Norman L. Greenman '44, president of Rogers, and Richard C. Berry '48, vice president—research and development, highlighted further M.I.T. associations with the new building and Rogers. Both Norm and Dick were present at the ground-breaking near the Rogers headquarters, as were young Joe Lurie and his father, Robert M. Lurie '52, S.B. and Sc.D. in Course X. Dick writes that the building design was created by the Boston architectural firm of Marvin E. Goody, John M. Clancy and Associates, Inc., whose principles are Marvin E. Goody '51 and John M. Clancy '56. Their representative on the project is Samuel L. Russell '48. All three have architectural degrees from the Institute.

Mechanical engineering is being done by Reardon and Turner, of which Frederick J. Turner '31, Course II, is a partner. Structural engineering is in the hands of Simpson, Gumpertz and Heger, Inc., Cambridge. The three principals, Howard Simpson, Werner H. Gumpertz and Frank J. Heger are all members of the Class of 1948; all have degrees in

Attending the 1969 ground breaking ceremonies at Rogers, Conn., for the new Lurie Research and Development Center of the Rogers Corporation were: (left to right) Norman L. Greenman, '44—President of the Rogers Corporation; Robert M. Lurie, '52—Plant Manager, Nyanza Company, Ashland, Mass., and son of the late Joseph M. Lurie, '21, for whom the new Center is named; Joseph D. Lurie, Robert Lurie's young son; and Richard C. Berry, '48—Vice President-Research and Development of the Rogers Corporation, shown breaking ground for the new structure. Below is the architect's rendering of the Center which will be ready for occupancy this year.



Courses I and XVII; all have master's degrees in building engineering; Werner has a B.E. and Howard and Frank have doctorates in Course I.

Thomas J. Allen, Jr., '63, Assistant Professor of Management at M.I.T. who obtained the S.M. and Ph.D. at the Institute, has contributed to the interior of the Lurie building relative to his research on the influence of architectural factors on communications in research and development organizations. He is conducting studies at Rogers of communications in the old and new R&D facilities. Dick Berry, S.B. and S.M. in Courses X and X-A, will have charge of the new center. Two other M.I.T. alumni will also be there, Richard T. Traskos '66, Sc.D., Course X, research engineer, and Edwin P. Tripp, 3rd, '67, S.B., S.M., Courses X, X-A, development engineer.

Saul Silverstein, Norman Greenman and Raymond St. Laurent all have S.B. and S.M. degrees in Courses X or X-A. Other Course X men associated with Rogers are Sidney A. Brown '28, vice president —engineering; Solomon Baker '39, regional sales manager—electronics; Michael M. Gottlieb '58, managing director, Mektron, N.V., Ghent, Belgium; Robert M. Hodges '60, production manager, circuit systems division.

Course XV is represented by Charles M. Gorman '56, director of purchases, and Course V by Francis J. McGarry '65, production manager, coating and laminating department.

Joseph M. Lurie grew up in Roxbury, Mass., and was a classmate of Saul Silverstein and Ray St. Laurent in Boston English High School, whence all three entered M.I.T. At the Institute, Joe was in the Chemical Society and Chess Club and a member of the track team. Following graduation in Course X, for which his thesis was written in collaboration with Saul, he was an instructor for two years on the Chemical Engineering staff at M.I.T. and then variously engaged in research with Boston Woven Hose Co.; Bigelow, Kent, Willard and Co., and as president of Advance Fiber Co. He was director of research for W. S. Libbey Co. and Bonafide Mills before going to Rogers as technical director in 1947.

His hobby was economics and some of his papers were published by a congressional subcommittee. He held patents in the textile and paper fields. Joe had two brothers, the late Eli Lurie '22, who earned S.B. and Ph.D. degrees at M.I.T. in Course V, and Jack Lurie, a Harvard graduate and also a chemist. Surviving besides his brother are Joe's wife, Mrs. Gertrude Lurie, Brookline, Mass.; his daughter, Mrs. Barbara Feigen, Ridgewood, N.J.; his son, Robert M. Lurie, Lexington, Mass., and six grandchildren.

Brockton, Mass. 02402; **Paul Smith,** Assistant Secretary, 11 Old Farm Rd., North Caldwell, N.J. 07006

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Most of us dream of leaving our normal occupation and taking off for the countryside to work in a self-owned business. A letter arrived recently from one of our classmates who has seemingly achieved this dream. **Jonathan E. Chorlian,** 42 Woodridge Rd., Durham, N.H. 03824, says: "For the past two years, I have been working as a free-lance full time artist craftsman in stoneware clay, porcelain, and silver. During the previous 15 years while working in engineering, I had taken art courses at the Boston Museum School and the Haystack School of Art in Maine. I gradually came to realize that the crafts were more interesting and challenging to me than conventional engineering. And I prepared carefully for the transition. Actually, my experience in the chemistry and engineering of ceramic and metal powders during my years at Ventron Corp. in Beverly, Mass., was invaluable. The engineering element is just as essential as the creative element in successfully producing them with sufficient efficiency to enable me to support a family with a reasonable standard of living. I sell a lot of my work through the shops of the League of New Hampshire Craftsmen. A number of other shops scattered through eastern New England from Nantucket Island to Maine also display my work. If any of you are in Cambridge, you can see some of my pottery at the Tech Coop and the Harvard Coop."

Fred Fickenwirth has been with the Boeing Co. in Seattle since his graduation. He has worked in the materials, processes and mechanical system areas. At present, he is a specialist engineer assigned to the B-1 advanced manned strategic aircraft program. His previous assignments were on the KC-97, B-52, 707, Minuteman, and SST programs. Fred reports that he is actively involved in Explorer Scout work in the Latter-Day Saints (Mormon) Church. . . . **Robert M. Lurie** reports that he was recently made director of materials at Avco Systems Division where his work is concerned primarily with government aerospace projects (composites and heat shields). Bob reports that he and his 14-year-old son Joseph recently attended the groundbreaking of a new laboratory at Rogers Corp., Rogers, Conn., which was named after Bob's father, Joseph M. Lurie, M.I.T. '21.

A note has come from **Forbes E. Forbes,** who is working for the Weston Hydraulics Division of Borg Warner Corp. as supervisor of design and analysis. Forbes has two children: Erik, 5 years and April, 2 years old. . . . The traveling bachelor of the Class, **Arnold A. Kramer,** writes that he has just returned from skiing in St. Moritz, Switzerland. He does admit, however, that he did do some business in Cologne, Germany while away. . . . **Gerhard Hover** writes that he was appointed vice president of operations for Setal Co., a joint venture with Lummus Co. of Bloomfield, N.J. He moved to Sao Paulo, Brazil with Judy and Joan in August of 1969. He and his family had previously spent a two-year assignment in Paris, France; and before that, six years in Germany. Gerhard has now spent 17 years with the Lummus Co. He sends his greetings to the Class.

Among the graduate members of our class, **George Powell Conard,** S.C.D. Course III, is currently chairman of the Department of Metals and Material Science at Lehigh University. . . . **Rolf T. Skrinde,** S.E., Ph.D., Course XI, professor of civil engineering at the University of Massachusetts at Amherst, has been named professor and chairman of the Department of Civil Engineering at the University of Iowa.—**Arthur S. Turner,** Secretary, Lowell St., Carlisle, Mass. 01741

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Should our twentieth reunion take place in Bermuda? This is a subject that we need to resolve within the next year, because it takes about two years to plan a satisfactory reunion in Bermuda—based upon the advice of the M.I.T. Class of '49 which held its 20th in Bermuda last June.

Stan Margolin, who was Reunion Chairman for his class last year, summarizes the results of the Bermuda experience as follows:

1. "The reunion was a success both in numbers of attendance, in terms of financial results to the class treasury, and in terms of overall class satisfaction.

2. "About 100 classmates and their wives and children attended the Class of '49 reunion in Bermuda last year. . . . it is essential to include not only classmates and their wives, but also their children, if the parents wish to bring them. On the average, each couple brought one child.

3. "A Bermuda get-together should be classified as a big party rather than as a reunion in the traditional sense. Everything must be done to make the travel schedule to and from Bermuda and the accommodations that are selected in Bermuda as attractive and convenient as possible. The reunion should last a full three days for all participants, because participating in only part of the reunion (e.g., the Saturday evening banquet) is not economically practical, unless a classmate is already in Bermuda.

4. "The planning activities for the reunion require a minimum of 1-½ years. With adequate advance planning, the airlines can be of considerable help in providing descriptive literature and brochures; the hotels, of course, are also willing and able to provide assistance.

5. "A highly flexible program is required. Daytime activities should not be organized; evenings should have some organization but should not be rigid.

"The economics of the Bermuda reunion were as follows, based upon staying three nights and four days: Round trip Boston/Bermuda or New York/Bermuda: $95 per person; double room with breakfast and dinner: $25 per person; total cost for travel plus lodging (for three nights), including service charges at 15%: about $200 per person. Thus, a husband and wife would spend about $400 together, and children under 12 would incur slightly more than half of the adult rate. These rates will probably be higher by the time 1973 rolls around. About three months prior to the reunion date the class members were asked to make a combination reservation-class dues contribution of $35 for the classmate and his family. Since many of the Class of '49 attendees went to Bermuda prior to the actual reunion date to start family vacations, no specific chartered flights were arranged for the class. The classmates also departed from Bermuda on scheduled aircraft."

A recent letter from **Ed Colbeth** indicates that he and his wife, Carol, vacationed in Bermuda last year, and they had a wonderful time. Ed is a strong supporter for a Bermuda get-together in 1973. The above recommendations and observations by the Class of 1949 suggest that a reunion committee chairman be appointed fairly soon for the Class of 1953 in order to resolve the reunion location, whether it be in Bermuda or at some nearer-by location. We would still welcome other comments and suggestions relative to Bermuda or any other ideas you have as to where the 20th should be held.

A recent letter from **Fred Zwerling** indicates that he and his family are prospering on Long Island. The family business which Fred joined in 1956, after working with the Air Force at Wright Patterson AFB, has recently been merged into P&F Industries, which is now listed on the American Stock Exchange. Last July, Fred was elected president and chief executive officer of P&F Industries. Fred and his wife, Elinor, have two sons and one daughter. . . . **Howard Wing** has recently been named director of product research for Raytheon Company, in the Boston area. Howard recently spent a year's leave of absence as a Sloan Fellow in the mid-career Advanced Studies Program at M.I.T.

Robert Price, now captain in the Coast Guard, is based in Washington as chief of planning and special projects staff in the Office of Merchant Marine Safety of the U.S. Coast Guard. Bob's work deals with a variety of problems including marine pollution and safety at sea. . . . **Ernest Rifkin** recently reports moving from Hartford, Conn., to Syracuse, N.Y., where he is now employed by Carrier Air Conditioning Company. Ernest lives with his wife, Shirley, and three children at 11 Eden Roc Circle, Dewitt, N.Y.

Bruce Beckley is still active in maintaining the Moose Hill Wild Life Sanctuary of the Massachusetts Audubon Society; he is working for the Yankee Atomic Electric Company as a project engineer. Bruce and his family live in Sharon, Mass. . . . **Ernest Allard** is now district manager with the process division of Universal Oil Products Company in Los Angeles. Ernest was formerly stationed at the company's headquarters in Des Plaines, Ill. Is the move toward unleaded gasoline having any noticeable effect on your business as yet, Ernest?

Stuart Solomon received his M.D. from the Medical College in Virginia last June. Stuart is presently a pediatric intern. . . . **David L. Klepper** has been active organizing a symposium and conference on organ and church acoustics that was held in the Chicago, Ill., area this past February. The conference was attended by organ builders, leading church architects both in the United States and abroad. Dave is with Bolt, Beranek & Newman.

Dick Ahrons recently resigned his position at RCA (Semi-Conductor Division) to found a new company, American Opto-Electronics, Inc. Dick's new firm has begun operations at Edison, N.J. Dick lists his home address as Bittersweet Terrace in Somerville, N.J. . . . **Howard Stern** reports that E-Z-EM Company, of which he is president, continues to serve the disposable markets for hospital supplies. He and his wife, Linda, have a two-year-old daughter, and another child is on the way.

George Abbott, who was formerly corporate manager of manufacturing and planning for A. O. Smith, has recently been appointed as head of the powder metallurgy division of A. O. Smith-Inland Inc., in Milwaukee. . . . **Russ Kidder** has been very active in the American Chemical Society and with the Chemical Market Research Association. Russ was recently named chairman of the Chemical Marketing Economics Section of A.C.S. Russ has been working for Stauffer Chemical Company for a number of years now. As you may recall, Russ was one of the stellar performers on M.I.T.'s varsity basketball team. One evening he scored 36 points—a total which probably is, or closely approaches, a Tech record. . . . **Richard Lockhart** is now pursuing quite unusual activities, both vocational and otherwise. Dick is currently the director of Waterfront and South Cove Urban Renewal Projects for the Boston Redevelopment Authority. He is also treasurer of the Fayerweather Street School in Cambridge, an independent experimental elementary school similar to the system developed in Leicestershire, England. . . . **Fred Vose** is now a project engineer with Newport News Shipbuilding and Dry Dock Company, a Division of Penneco, Inc.

Now for recent changes of address. I'll only skim through the large list which has accumulated in the past several weeks. . . . Gene McCoy, one of Tech's great riflemen back in the early 50's, now lists his address as 5710 Winton Rd., Cincinnati, Ohio. . . . Bill Young now lives in Middletown, Ohio, on Barbara Drive. . . . Chris Whitecombe lists his mailing address as Du Pont's International Department in Wilmington, Del. . . . John Harding currently resides at 350 M Street, S.W., Washington, D.C. . . . Art Winquist now lives on Northwestern Drive in Topeka, Kan. . . . Gene Hilton, apparently still in the service, lists his address as Hqs. MAC, Box 101, APO San Francisco, Calif. 96222. . . . Bill Shapiro is currently living in Hazara, West Pakistan, at the Tarbela Dam Colony. . . . Jake Pinkovitz now lives on Margaret Road in Sharon, Mass.—**M. C. Manderson,** Secretary, Longley Rd., Groton, Mass. 01450

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Although I am sure that most of you would rather read items of choice gossip, we shall burst that balloon at the start by informing you that most of the items this month are professional in nature.

A clipping from the Mt. Sterling, Kentucky *Advocate* (circulation 3,887) stated in bold type, "Petrology Being Taught by Dr. **C. T. Prewitt** in New York." It goes on to say that Charlie is now an associate professor at State University of New York, Stony Brook, Long Island, and that petrology is the science of rocks. For the past seven years, Charlie had been with du Pont at Wilmington, Del. At Stony Brook a new program has been established in the Department of Earth and Space Sciences for graduate students interested in the M.S. or Ph.D. degree.

While we are on the subject of terra firma, Professor **Charles C. Ladd,** who is head of the Soil Mechanics Division of the M.I.T. Civil Engineering Department, was guest lecturer in March at Purdue. Charlie was the initial lecturer under a new grant presented to Purdue for the "general development of soil mechanics."

In April, **Max D. Musgrove** presented a paper on the "Development of Titanium Structural Element Allowables for the Boeing SST" at the AIAA/ASME 11th Structures, Structural Dynamics, and Materials Conference that was held in Denver, Colo. Max is with the aerospace division of Boeing. Also in April, **L. Dennis Shapiro** presented a paper, "Using Loran-C Transmissions for Long Base Line Synchronization" at the Very Long Baseline Interferometry Symposium, held at the National Radio Astronomy Observatory in Charlottesville, Va.

Charles F. Rockwell has been promoted to engineering manager/controls at Fenwal, Inc., in Ashland, Mass. . . . Dr. **Lawrence C. Hoagland** was recently elected a director of Steam Engine Systems Corp., Newton, Mass. Larry is also vice president and director of research. The company is engaged in the development of steam engines of

advanced design to meet the increased demands for propulsion systems with low pollution, low noise and high torque characteristics.

Bob Greene and family are in Jakarta, Indonesia where Bob is assistant to representative-administration for the Ford Foundation. His wife Edie writes that since they are about 13,000 miles away, it will be a little difficult for them to make the reunion this year. Bob is finding the job most challenging and interesting and is working an "8-day week." The Greenes find life in Jakarta very different and very interesting even though, with the high population growth there, privacy is at a premium. They have 5½ servants, cook, washmaid, houseboy, driver, night watchman and gardener who is the one-half servant because he divides his time between their house and one other.

Bob's work entails working with both Indonesians and Americans and consists of a multitude of duties, some of which are setting up procedures, reorganizing the office, dabbling in budgets and policy making regarding benefits to employees. As Edie puts it, "Anywhere there is disorder, he is creating order." The Greenes expect to be back in the States from mid-August to mid-September when they will be visiting with friends, and then return to Indonesia via Europe. They send their regards to everyone and hope to see everyone at the next reunion—Secretaries: Mrs. **J. H. Venarde,** (Dell Lanier), 16 South Trail, Wilmington, Del. 19803; **L. Dennis Shapiro,** Aerospace Research, Inc., 130 Lincoln St., Brighton, Mass. 02135

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Last month's complaint about the paucity of returned questionnaires jarred loose a few in the pipeline—nearly doubling our receipts! As we write for the June issue we're reminded that another M.I.T. Homecoming is upon us, the last one before our 15th comes around. Gee! Didn't we just celebrate our 10th? I'm sure we all noticed that photo from the 1956 Tech Show featured in the Homecoming publicity, which reminds us that **Mickey Reiss'** "crowning moment" at the 1955 Junior Prom is still getting space in the general catalogue . . . and not a dime in royalties! The students may be smarter these days, but they're not so photogenic.

A quick pass through a dozen or so returns indicates a lot of world travel (T.R. advertising manager take note!). **Devon Schermerhorn** writes from his home in Aruba that he has travelled from Lisbon to the North Cape, last year, and will go to Alaska this year. What's more, he's casting interested glances toward Australia. As a supervising chemist for Lago Oil and Transport Co., Ltd., he finds the chemistry of people his most consuming task. He reports that Derek Allen, '57, is, or has by now transferred to London with Esso. . . . It's nothing new to hear that **Roger Borovoy** is flitting around the globe for Fairchild Camera and Instrument Corp. He took Brenda to Europe and Greece last spring and liked it so well that he returned for a couple of weeks in the fall, alone. Roger is a patent attorney whose responsibilities involve licensing agreements. Your cosecretary spent a delightful evening in their Los Altos home on behalf of the Alumni Fund a year or two ago, and the architecture alone is worth the visit!

Jack Rosenfeld, whose marriage in Copenhagen was previously reported, tells us his travels included Denmark, Tunisia, Sweden, Scotland, England and Portugal. He's back in New York where, outside of drawing a salary from I.B.M., he teaches at Columbia University, practices Scottish country dancing (never could keep his feet still!) directed a show at the county home and recommends Danish girls to one and all. . . . **Bruce Wedlock** has returned to M.I.T. from West Berlin where he spent a half-year teaching at the Technical University. His specialty is solid state devices.

Ronald Goldner, who holds an associate professorship at Tufts, spent several months in India, teaching at the Summer Institute as an N.S.F. consultant. . . . **Stuart Frank,** practicing and teaching medicine in San Francisco at the University of California Medical Center, reports his return from an expedition to Mt. Everest and five weeks skiing in Nepal or was it the other way around? Ah, the life of a bachelor!

Mike Turin and family are due to return to the U.S. this summer after three years overseas with IBM World Trade. The Turin family currently has the lilting address of Hursley House, Hursley Park, Winchester, Hants, England. Mike is manager of the Complex Systems Design Center and manager of Complex Systems Marketing for IBM (U.K.). He also reports that the English schools are doing great things for his children—long hours, heavy workload, no frills in the facilities but they like it.

Richard Quinn, whose address is Willingboro, N.J., reports that he has joined the ranks of patent-holders, and has been elevated to manager, technical administration, for R.C.A. Labs. While he doesn't consider himself a world traveler, he did manage a vacation trip to St. Thomas in December, and for the father of four, that's not bad! So much for the nomads . . . we'll cover the stay-at-homes in another installment.—Cosecretaries: **Bruce B. Bredehoft,** 3 Knollwood Dr., Dover, Mass. 02030; **T. Guy Spencer, Jr.,** 73 Church St., Weston, Mass. 02193

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The *Wall Street Journal* carried an interesting little item about the Fantus Company, the firm in which our **Roger Yaseen** is vice president. I quote in full:
"A consulting firm that tells ohter companies where to move said it is taking its own advice and getting out of New York City. Fantus Co., the plant-location subsidiary of Dun & Bradstreet Inc., said that later this month it will move most of its staff from midtown Manhattan to temporary quarters about 15 miles west in West Orange, N.J. Permanent quarters are being built in South Orange. 'We have found that everything in New York is literally impossible,' said Fantus' chairman, in explaining the move. He said, 'Operating costs are reaching exorbitant levels,' rents and taxes are rising and 'people simply won't live in New York or commute to New York.' Not everyone is moving, however. Mr. Yaseen said he and about half-dozen sales executives will remain at the old Park Avenue headquarters for a while.

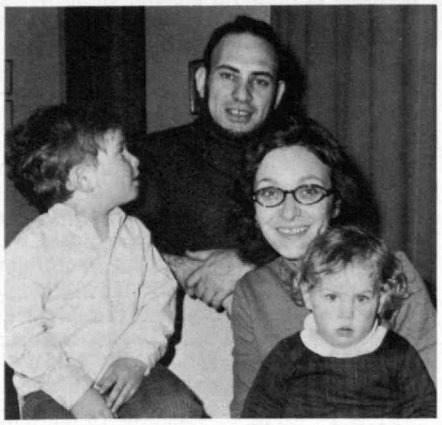
An interesting letter arrived back in January from **Jerry Marwell:** "For some reason I scratched into the flap of my last Alumni Fund 'please contribute' envelope a few brief ironies concerning what has happened to me since 1957. It is partly in hope of heading off the publication of those lines that I send this more complete, and perhaps more sane letter. A second reason is that my wife and I expect to be in Helsinki around Easter, probably with our two children, and if you are serious about wanting to see any Tom, Dick or Jerry I seem to have developed a similar feeling myself much to my surprise. Please let me know if you will be available.

"About myself. I am still married to Bobbie, whom I married immediately upon graduation, and we have two children—a boy and a girl. I received my Ph.D. in sociology from New York University in a particularly macabre fashion—while the faculty was debating whether to accept my dissertation I heard that President Kennedy had been killed (I was waiting in an outside hall).

I am currently an Associate Professor of Sociology at Wisconsin (Madison) where I have been for seven years. This year, however, I am on leave to do research in Oslo. My most extensive research to date has been on the subject of interpersonal cooperation and has been experimental in nature. I have also published in other areas, however, and expect to have a book out sometime this year concerning some research on students who worked in the civil rights movement.

"Much of my spare time recently has been spent discussing things with students and discussing students with everybody else. One of the courses I have taught every year has been a large introductory lecture on social problems and this makes me a natural target for questions which are of pressing concern. This also makes me spend an inordinate amount of both my professional and private life thinking about the state of the world and our society. I say inordinate because I suspect that basically I would prefer to spend my time in more pleasant, personal pursuits.

"Such as sports. I still manage to play



Gerry Marwell, '57, and family

football and basketball in season but it gets a bit harder every year. Recently I discovered squash (and had five stitches in my head from examining a racquet too closely) and badminton—both great games. I also persist in reading everything I can get my hands on and driving my wife crazy by spending hours at the TV watching the next-to-last-place Packers (the rest of you cannot understand the extremity of local agony) play the last place Saints. I think that is why she was anxious to come to Europe this year.

"I am more cynical, less theatrical, 15 pounds overweight and losing my hair.

"Since **Marty Goldstein** will never write himself, and since I think at least a few people might like to know, he received his Ph.D. in mathematics from Wisconsin last year. His dissertation was on branching processes and I was the 'outside' member of his committee. He is currently on a post-doc at Montreal."

Just a few weeks ago, Gerry and his family stopped by Helsinki on their way to Leningrad. On this page you see a photograph of the Marwell family I took in our living room. Gerry looks revolutionary but don't believe it; he drives a big new well-known German car! The Marwells are returning to the States this summer.

Donald Jarrell dropped us a note as follows "Since graduation, have spent two years with the A.E.C.; three years at Lawrence Radiation Laboratory plus varied Navy tours. Presently operations officer, U.S.S. *Coral Sea* in Southeast Asia. Recently selected for captain, U.S. Navy. I have orders to Washington as head, Weapons Technical Branch, Atomic Energy Division, Office of the Chief of Naval Operations." . . . **John Jones** is now an advisory engineer with I.B.M. in Research Triangle Park, N.C., working with communications terminals. . . . **Carl Estes** has been made a partner in the Houston law firm of Vinson, Elkins, Searls and Connolly. . . . **Bruce Blanchard** has transferred from the staff of the U.S. Water Resources Council (where he worked for three years) to the staff of the secretary of the interior. He writes that he sees Bing Cody regularly, adding that Bing is on a sabatical from Cornell to the reactor licensing division of the A.E.C.

. . . Hey! How 'bout sending me a postcard when you're on vacation and giving me some news? You can't be so busy then.—**Frederick L. Morefield,** Secretary, Tiirasaarentie 17 Lauttassaari, Helsinki 20, Finland

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Our Class Hero of the Month is **Paul Berger,** who writes that he is an assistant professor at Boston University. He is currently teaching in Frankfurt, Germany in the Graduate Overseas Program in Business. Paul received his Ph.D. from the Sloan School at M.I.T. last June. He, his wife, and their toy poodle are enjoying themselves in Europe. Paul notes that **Paul Clermont** has bought a house in Newton Highlands, Mass., and that **Mark Alpert** is doing well on the faculty at the University of Texas.

Namik Aras (Ph.D.'64) has returned to his home in Turkey to establish a Middle East technical institute similar to M.I.T.

Robert Blumberg has left the U.S. Department of Defense and is now working for J. H. Whitney Co., a small venture capital firm in Manhattan. . . . **Leonard Chess** is a resident physician in internal medicine at the Columbia-Presbyterian Medical Center. Len is now the father of two children.

David Dunford is a foreign service officer in the American Embassy at Helsinki, Finland. He and his wife Sandra had previously been with the Embassy in Quito, Ecuador. . . . **William Evers** received his Ph.D. in aerospace engineering at Cornell this January. He is now with the research department of Rocketdyne in California. . . . **Michael Gold** is an associate professor of administration at the University of Pittsburgh. He had previously been on the faculty of Carnegie-Mellon and an assistant director of its computation center.

Eugene Grumer is a senior process analysis engineer for Celanese Chemical Company. He and his wife Sue have two children, still leaving them time to take flying lessons for a private license.

David Guttman, with the M.I.T. electrical engineering department, delivered an address at the December, 1969 meeting of the American Association for the Advancement of Science concerning secret labs and special interests. . . . **Lawrence Kaldeck** is presently a senior scientist in the mathematics department of Avco Systems at Wilmington, Mass. . . . **Joel Kalman** is the regional chairman of the Alumni Fund in Arlington, Mass.

Peter Politzer received his Ph.D. in astrophysics from Princeton last December. . . . **Ronald Randall** is consulting with a new community college being built in South Bronx on the design of a computer managed individualized instruction system. . . . Mrs. **Enid Schoettle** is an assistant professor of political science at the University of Minnesota.

Robert Scott is now the director of information processing services at M.I.T. with responsibility for developing coordinated plans for the growth and interaction of the Institute's various computation services and information processing activities.

David Sheena received his Ph.D. in electrical engineering at M.I.T. last June, and is presently working at Space Sciences, Inc. in Waltham, Mass. . . . **Albert Teich** is a Ph.D. Fellow at the Syracuse University Research Corporation. He was a speaker at the 1969 meeting of the American Association for the Advancement of Science. . . . **James Wasvary** received his M.A. in biochemical sciences at Princeton in December, 1969. . . . Let me hear from you.—**Ron Gilman,** Secretary, 5209 Peg Lane, Memphis, Tenn. 38117

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J. D. Roach is now the director of management information systems and contract accounting at Northrop's Ventura Division in Newbury Park, Calif. He and his wife are expecting their first child in July. . . . **Harry Don** has passed all of the Society of Actuaries' examinations. . . . **Charles Seitz** has co-authored a paper on a standard that translates simultaneously between the U.S. and European wirephoto networks.

Mark Hanson recently lectured the American Association of Cost Engineers on time-sharing cost control systems for architects and contractors. Mark is currently a research engineer at Bolt, Beranek and Newman in Cambridge. . . . **Peter Wolk** is in Hollywood working as the manager of programming services for Liberty Records. He and his wife, Anne, celebrated their third anniversary with a European vacation in April. . . . **Dick Schmalensee** and **Jerry Wilcox** were both promoted to assistant professors at the Sloan School last February.

Phil Siemens is spending a year at the Niels Bohr Institute in Copenhagen. . . . **Piermaria Oddone** received his Ph.D. in physics from Princeton. . . . **Bruce Bottomley** is completing his master's in computer science at Washington State.

T. H. Morrin has taken a leave of absence from Boeing to finish his Ph.D. work in electrical engineering at the University of Washington. . . . **Sharon Ross** and husband, Bill, are both back in school again. Sharon is currently the Secretary-Treasurer of the Georgia division of the National Fencing League. . . . **Michael Graham** is serving out his navy obligation at the Armed Forces Radiobiology Research Institute in Bethesda. He is also completing his Ph.D. in biophysics at Berkeley.

Dave Cohn reports the birth of a son, Alan Jay, last September. . . . **Rich Olsen** married the former Miss Linda Bernhardt in February 1969. Since then their time appears to be equally divided between mountain climbing, sailing, skiing and graduate studies.—**Jim Wolf,** Secretary, Brigham Rd., Gates Mills, Ohio 44040

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We have been reading about the postal strike in the United States, and that undoubtedly accounts for the dearth of letters this month. With my Ph.D. thesis due in a month, it's just as well there are only a few. We were pleasantly surprised last week with a brief unexpected visit of Kevin Kinsella '67. He is now living in Stockholm, Sweden, and plans to embark upon a world-wide journey later this year.

Second Lieutenant Terry May has now received his orders to go to Vietnam in June. He is the Field Artillery Division of the U.S. Army. . . . **Ray Petit** expects to complete his master's degree in June and is awaiting orders for the Naval Research Lab in Washington, D.C. . . . **Larry Schwoeri** has transferred to Rohm and Haas's Film Development Lab in Bristol, Pa. His new job will involve developing new applications for plastic films as well as some technical support of customer service. . . . **Mike Marx** and **Louis Bucciarelli** co-authored a paper at the recent AIAA 3rd Communications Satellite Systems Conference. Mike is a staff member at the Lincoln Labs, and Louis is an assistant professor of aeronautics and astronautics at M.I.T.

Several classmates have new positions to report. **Peter Addis** has accepted a position with Computek. . . . President Nixon has nominated **Tim Carney** for promotion to Class 6 in the foreign service, following a recommendation by the Foreign Service Selection Board. Presently he is still assigned to the American Embassy in Maseru, Lesotho, as second secretary and international relations officer. . . . Marilynn and **Bob Poole** have just moved to the West Coast where Bob has been appointed to the systems engineering staff of Public Safety Systems, Inc., a subsidiary of General Research Corp., of Santa Barbara, Calif. Previously, he was a systems analyst for Sikorsky Aircraft in Connecticut. After receiving his S.M. from M.I.T. in 1967 he also did some graduate work at N.Y.U. in operations research.

In the morning's post was a letter from **Dan Dedrick** detailing some of his activities over the last couple of years. In June he receives his M.D. from Yale Medical School and will stay on as an intern in surgery at the Yale-New Haven Medical Center. This makes his wife, the former Carolyn Gissen, '69, rather happy as she too is a med student at Yale. Dan is in the navy reserve so he's managed to stave off Uncle Sam. He reports the following of some of our Class: **Roger Samuel** is now at Boeing in Seattle after getting another degree from M.I.T. last June. . . . An unconfirmed rumor is that **Joe Adolph** may also be going to Yale as an intern at the end of June. Dan invites anyone driving the New York-Boston route to drop in, right by the I-91 and I-95 connection. . . . Warren Henderson, '33 dropped a note saying that three of our classmates attended the recent 1970 M.I.T. Mexico City Club Fiesta: **Enrique Luis Corona, Johan Palme-Sierra, Herbert Weinstein-Wishnack,** and his lovely Rebecca.

The Class Hero of the Month award goes to **Bill Cain** for a rather unique consulting job. He made the 1970 schedules for the National and American Baseball Leagues. The mathematical theory behind the scheduling problem is the subject of his D.B.A. thesis at Harvard Business School. So blame him if your favorite team isn't in town on the night you want to go to the ballgame!

After this summer we reluctantly leave our home in Oxford to return to the United States. England has been good to us in our two years here. We've acquired a Ph.D. (or soon will), met many fascinating people from all around the world, absorbed some of the unique British history and culture, and had our daughter Anne born here. Our destination is at the foothills of the Rocky Mountains, Fort Collins, Colo. I've accepted a position as an assistant professor in the departments of Mechanical Engineering and Physiology and Biophysics at Colorado State University. Our new mailing address is found at the end of these notes. Have a real pleasant summer and drive carefully if you're on the road. Cheers—**Terry J. Vander Werff,** Secretary, P.O. Box 368, Fort Collins, Colo. 80521

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Paul Greene sent me the following letter. "Dear Jim, I have just finished reading several back issues of *Technology Review.* I was disappointed to see that so many of our classmates have chosen to use their expertise and talent destructively—in the armed forces and in corporations that make possible the war on people. Could you please note in your next column that I have refused induction in Oakland, Calif., and I am currently waiting for a trial date to be set. I am sure that there are others in our Class who are trying to confront the repressive forces in our country. Perhaps you could encourage them to write. Following the example of the Class of '68, you might create a category for the first classmate to refuse to do war research, etc. Thank you. For a world that is safe from American oppression, Paul Greene, 1805 A Dwight Way, Berkeley, Calif. 94703."

From the other side of the world I've received a letter from **Gary Ender** in Nepal with the Peace Corps. Actually I've read that Nepal is the *in* place with the jet set; even Spiro visited there recently. However, Gary doesn't seem to travel with that crowd. He writes "Listening to the astronauts walk on the moon is quite incredible over here where 18 miles can easily be a day's journey. In the hills they don't even have wheels, because there's no use for them. Being here is an incredible experience, although the PC publicity is quite accurate that we don't change the world overnight. 'Achievements' are slow to come, but by the same token, that much more savored by the volunteer. The ag program here is sort of in low or medium gear. A good kick (or a job well done) here and there and it'll really take off. Thus we came at a fortunate time. Wheat is the dream easy crop, but rice is the diet staple and a very tough crop to improve on. Corn, jute, and vegetables also have improved varieties and I should sell at least a few metal plows this winter. The people are warm and friendly and expert at shooting the shit, which there's plenty of time for."

Brad Cross is working for Gulf General Atomic in gamma-ray spectroscopy. He has been a scoutmaster for two years, but he had to give that up in order to find time to go to San Diego State College part-time. He's working for an M.S. in chemistry. . . . **Abid Ilahi** will receive his M.B.A. from Harvard Business School in June. . . . **Jerry Cook** is working as an engineer in the Ryukyu Islands and has projects throughout Asia. He published a short article in the October-November issue of *Technology Review.*

U.S. Air Force Sergeant **Thomas Hughes** is a radio repairman at Clark AFB in the Philippines. He was previously at Langley AFB, Va.

On April 8 **Tomme Ellis** was released from active duty in the U.S. Army. He's planning to return to graduate school this fall in the area of ecosystems engineering, but he hasn't yet decided upon a school. . . . **Yuji Ito,** Ph.D., has returned to Japan as an assistant professor at the Institute for Solid State Physics, University of Tokyo. . . . Lieutenant Commander **Paul Amesse,** U.S. Navy, is commanding officer, Naval Electronic Systems Command, Midwest Division, Great Lakes, Ill. . . . **Sheldon Bayer,** having completed his M.S.E.E. at Washington University, is in Navy OCS at Newport, R.I. His wife Jackie writes that their first child, a son, Matthew, was born July 23, 1969.—**Jim Swanson,** 816 First Avenue North, Grand Forks, North Dakota 58201

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The mailbag was pretty light this month —is everybody out there dead? I am very familiar with the end-of-winter malaise, but this is ridiculous. Predictably, Mike had decided I should do the coumn this month, but I must admit, he told me that before he knew it would be quite such a lean month. By the time you see this plea for more material, it will just about be summer, and you all should be energetic and just rarin' to write us a letter and let us know what you've been doing. How about it? I'm especially aiming this at those of you who have been reading this column all this time and have never sent anything in. Do you realize that it's been two years now—Mike and I haven't missed a column, and that gets difficult when nobody sends us news. Something must have happened to you in the past to years, and you couldn't be that much busier than the people who have taken the time to write us. Think about it.

I ought to point out a few more of the mechanics of producing this column. We get the notes and write the column several months in advance of the publication date and submit it to the *Technology Review* office, where it may undergo a few changes due to the overall length of the class notes for that month, last minute corrections, etc. That is why, for example, we have occasionally commented that we had a long column for that month, and then it just wasn't so. Some of the news was cut from the end and held over for the next month Really, we wouldn't lie to you!

We have to start this month's news items with a big apology to **Mark Johnson,** who we erroneously married off to Katie Fitzgerald in the October/November 1969 column. Mark wrote us to correct the mismatch. Katie actually married **Ellis Eves,** who had been Mark's apartment mate last year. Mark, his bachelorhood still intact, is currently working for G.E. in Paris, trying to put together the automation equipment for an Algerian cement plant.

Two "new" weddings to report this month. **Eric Schuetz** as married to Cecile Wood of Dedham, Mass., last June. Eric writes that he is now on the manufacturing management program with General Electric. He has spent one year in Lynn, Mass. in the aircraft engine group, and is currently in Schenectady, N.Y. in the gas turbine department. There is one more year to go in the program, after which he hopes to go to Harvard Business School. . . . **Carol Botteron** writes that she married **Gary Goddard** (M.S.'68) on April 19. She is now editing science books for Houghton Mifflin Co., and he is an electrical engineer for Raytheon.

We've collected a few "quickies", mainly from change-of-address forms, that we can report, but, of course, we have no details on these. **William Donahue, Jr.,** is now at the Naval Ship Research and Development Lab in Annapolis, and **David Bainum** is at Edgewood Arsenal, Md. That's all the military news for the month, and I think it sets some sort of record for our columns. We can't always tell what people are doing from the address forms, but we have picked up a few at various universities: **Emil Friedman** is at Princeton; **Douglas Goodman** is at Duke University and **Tom Brosterman** is at the University of Southern California. Also, **Ogden Hammond** wrote that he is returning to M.I.T. full-time for his Ph.D.

The only other item in the mailbag (yes, it was that bad!) was a clipping from *Novus,* the alumni publication of the Graduate School of Industrial Administration, Carnegie-Mellon University. The clipping was a review, co-authored by **John Niles,** of the book *Black Capitalism,* by Theodore L. Cross (Athenuem, 1969). The book describes the current economic situation of American Negro ghettos, and proposes some guidelines for public and corporate policy for the ghettos.

Finally, I want to report that Mike was recently elected as a Course VI representative to the Graduate Student Council for the coming year. The other Course VI representative is **Alan Gilkes,** who is enrolled as a special student while stationed at Hanscom Field.—**Gail** and **Mike Marcus,** Secretaries, Apt. 16A, 60 Wadsworth St., Cambridge, Mass. 02142

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This month marks the first annual observance of our graduation from M.I.T. Please keep me informed as to your latest adventures (marriages, employment, education, military, etc.) so that I can share them with our classmates. Also, if any of you have lost touch with a former classmate, get in touch with me. The Alumni Office is kind enough to keep me posted on all address changes.

Larry D. Fuller as been commissioned a second lieutenant in the U.S. Air Force upon graduation from Officer Training School at Lackland AFB, Texas. Larry is currently assigned to Sheppard ABF, Texas, for training as a missile officer. . . . **Mark A. Rockoff** has completed his first year at Johns Hopkins Medical School. Mark writes, "I have only about eight more years to go before I'll start to earn a living." He has obtained a grant from the National Institute of Mental Health and will be working this summer in the Department of Psychiatry at Massachusetts General Hospital in Boston.

Emily C. Leonard is currently employed as a senior planning consultant in the technological and social science divisions of Abt Associates.

Claudia and **Larry Viehland** have passed qualifying exams for the Ph.D. program in chemistry at the University of Wisconsin. They also send word that **Betty Recks** is working towards a Ph.D. at U.C.L.A. in geology.

Charles Bures is finishing requirements for his master's degree in electrical engineering at Stanford for graduation this month. . . . **Kerry W. Bensman** and **Lawrence A. Stelmack** have joined Digital Equipment Corporation of Maynard, Mass. Kerry is working as an applications programmer while Larry is employed as a diagnostic programmer.

Since this is the month when young hearts respond to wedding bells, I am happy to announce the marriage of **Richard G. Marcus** to the former Miss Beth Applebaum, a Boston University graduate. Dick is studying for his master's degree at M.I.T.

I'll be working in New York City for Chemical Bank again this summer so until further notice please send all correspondence to the following address—**Richard J. Moen,** Secretary-Treasurer, c/o *Technology Review,* Room E19-430, Cambridge, Mass. 02139

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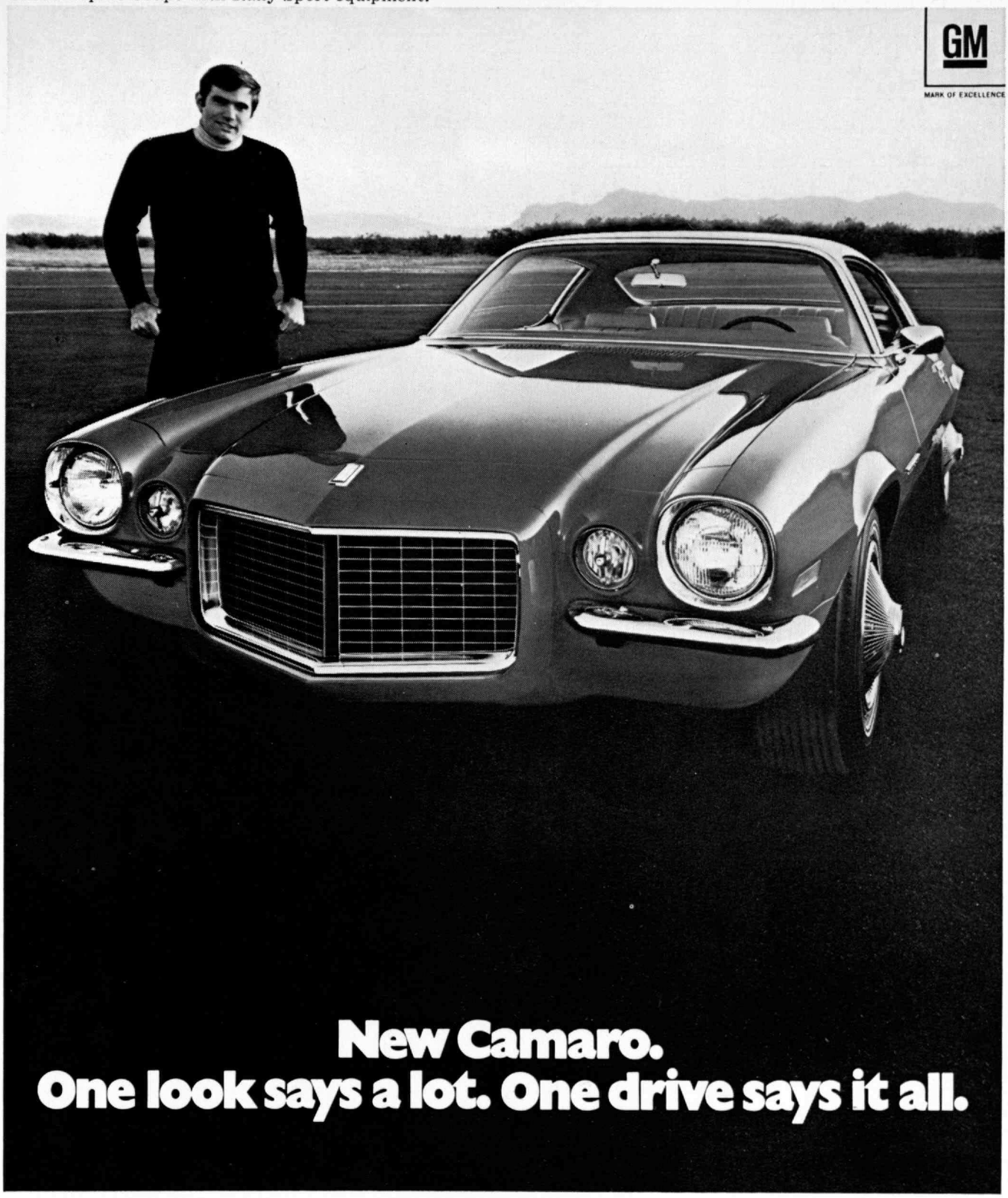

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